ABSTRACTS

08012 **Abranson, Christian E.** A discussion of the alternating field method and new paleointensity measurements of the Miocene geomagnetic field in Oregon: Pure and Appl. Geophysics, v. 82, p. 189-221, illus., tables, 1970.

Thirty-eight cores from five Miocene lavas and their underlying baked zones from southeastern Oregon have provided a test for the alternating field method of determining geomagnetic paleointensities, by allowing external as well as internal consistency tests. Different specimens from the same core behaved differently during the various experiments, proving that two specimens from a given core cannot be assumed to be identical. A relation between the oxidation state and a change of susceptibility upon heating is seen. The paleofield intensities varied from 0.17 ± 0.04 Oe and 0.31 ± 0.08 Oe, corresponding to virtual dipole moments of 1.23×10^{25} to 2.15×10^{25} Oe cu cm. These low values are not accompanied by virtual geomagnetic pole instability, but suggest an instability of the strength of the main dipole. — *from* Author's summary

07859 **Adams, John A. S.; Gasparini, Paolo.** Gamma-ray spectrometry of rocks: Amsterdam, London, New York, Elsevier Publishing Co., 295 p., illus., tables, 1970.

The gamma-ray spectrometry of rocks is of interest to geochemists, exploration geologists, and radiological health physicists. Titles of the seven chapters are: physics of gamma and X-rays, detectors, laboratory and field instrumentation, gamma-ray emitters, calibration of laboratory spectrometers and analysis of spectra, related and collaborative techniques, and case histories. These histories include geochronological, geologic tracers, heat flow studies, disequilibria in natural radioactive series, lunar gamma spectrometry, tektites and meteorites, and economic considerations. Three appendices contain absorption coefficients from data reported by Grodstein (1957), gamma spectra of natural isotopes and fall-out fission products, and determinations of U, Th, and K_2O in interlaboratory geochemical rock standards. — *from* Authors' abstract

00404 **Adams, William M.; Peterson, Frank L.; Mathur, Surendra P.; Lepley, Larry K.; Warren, Clifton; Huber, Richie D.** A hydrogeophysical survey using remote-sensing methods from Kawaihae to Kailua-Kona, Hawaii: Ground Water, v. 9, no. 1, p. 42-50, illus., 1971.

Several geophysical techniques have been specialized for applications to exploration for ground water in an insular basaltic environment. This article describes a multidisciplinary application of several such techniques to the Kona Coast of Hawaii. Aerial infrared scanning and low-level aeromagnetic surveys were the major reconnaissance techniques. For detailed study, modified audio-magnetotelluric and d-c resistivity profiling methods were used. The improved knowledge of subsurface structure confirmed the expectation that no large flows, such as suitable for commercial exploration, occur in that coastal sector. — Authors' abstract

Adams, William M. *See* Lepley, Larry K. 00582

07782 **Adams, William Mansfield.** An electrical resistivity profile in Hawaii with novel elevation correction: Geophys. Prosp. [Netherlands], v. 18, supp., p. 728-737, illus., 1970.

In order to locate relatively optimum sites for drilling exploratory holes for fresh water, an electrical resistivity survey was conducted along the new Mahukona-

Kawaihae Road on the west flank of Kohala Mountain. Two resistivity soundings made at the same stations, using the Schlumberger electrode configuration, determined an *a* spacing of 275 feet for horizontal profiling with the Wenner array. The correlation coefficient of the elevation to profile data was 0.41. A procedure for removing elevation effect from observed apparent resistivity was developed. Based on the reduced resistivity profile, four relatively optimum sites for additional exploration, such as by drilling, are specified. There is no specific interpretation of the data that can definitely indicate the occurrence of large underground reservoirs of fresh water anywhere along the profile. This is because the interpretation of horizontal profiling data is essentially relative and not absolute. — Author's abstract

07855 **Adelman, M. A.** Economics of exploration for petroleum and other minerals: Geoexploration, v. 8, nos. 3-4, p. 131-150, 1970.

Exploration is only one of several methods of increasing mineral supply and it is this substitution which makes a mineral industry stable. Exploration is a search not for new minerals, but rather for new cheaper deposits whose total finding-plus-development-plus-extraction costs will be lower than long-run incremental development-plus-extraction costs on existing deposits, which are a ceiling, or Maximum Economic Finding Costs. Very little is known about mineral investment, profits, and rates of return. The valid way of reckoning exploration cost is as a probability of finding new deposits of a given extraction cost. This is the present frontier of knowledge. — *from* Author's abstract

Afghan, B. K. *See* Goulden, P. D. 07784

00406 **Agarwal, A. S.; Singh, B. R.; Kanehiro, Y.** Soil nitrogen and carbon mineralization as affected by drying-rewetting cycles: Soil Sci. Soc. America Proc., v. 35, no. 1, p. 96-100, illus., tables, 1971.

The temperature of drying as well as drying-rewetting cycles enhanced N and C mineralization. Greater N release was found when incubation after drying was included than when omitted. A highly significant correlation existed between rates of N and C mineralization per cycle. Significant correlation also existed between the C/N ratio of the soils and N released during drying and rewetting followed by incubation. — Soil brief

07905 **Ahrens, Thomas J.** Directivity of seismic radiation from a series of line charges, *in* Symposium on engineering with nuclear explosives — Am. Nuclear Soc. and U.S. Atomic Energy Comm., Las Vegas, Nev., 1970, Proc., V. 2: Springfield, Va., Clearinghouse Federal Sci. and Tech. Inf., p. 1150-1159, illus., 1970.

A series of two-dimensional calculations describing stress-wave propagation from a row of line explosive sources, detonated sequentially at a supersonic phase velocity on the surface of various layered crustal models, was carried out. Spectral ratios of the resulting free-surface velocities at a series of hypothetical seismic stations were used to calculate directivity functions. Strong enhancement of certain frequencies in the spectrum of the horizontal component of velocity was obtained. Directivity is especially prominent when explosion-induced signals are generated in a medium in which longitudinal elastic wave velocity is comparable to the detonation phase velocity and when the seismic signal being analyzed has been refracted from a higher-velocity, underlying layer. — *from* Author's abstract

Aki, Keiiti. *See* Boore, David M. 00472

07801 **Akker, F. B. van den; Harrison, C. G. A.; Mudie, John D.** Even more on the direct interpretation of magnetic anomalies: Earth and Planetary Sci. Letters, v. 9, no. 5, p. 405-406, illus., 1970.

The total magnetic field fluctuation close to the sea floor has been measured and shows high amplitude, short wavelength anomalies. They have a 3-km wave length and an amplitude of 500 gammas. Upward extrapolation on the basis of two-dimensional structure and the Laplacian behavior of the Naperian logarithm of total field

intensity would give an amplitude of 0.04 gammas at the surface for these anomalies. Diurnal variation measurements are not sophisticated enough to permit this detection because of the limits of error, so that calculation of magnetization intensity variations by inversion of sea surface fields is extremely unlikely to reproduce the actual magnetization realistically when one is interested in describing fluctuations in intensity of magnetization over the sea floor which are comparable or less than the distances separating the source of magnetization and the observing device. — HRC

07735 **Alabama Geological Society; Bentley, Robert D.; Neathery, Thornton L.** Geology of the Brevard fault zone and related rocks of the Inner Piedmont of Alabama — Alabama Geol. Soc. field trip, 8th Ann., 1970, guidebook: University, Ala., Alabama Geol. Soc., 119 p., illus., tables, 1970.

The Brevard fault zone abruptly changes strike from N. 40° E. to N-S at Horseshoe Bend, Ala. Recent studies find that: metasedimentary rocks of the Brevard zone, mapped south of Horseshoe Bend around the Inner Piedmont, appear to be continuous with similar metasediments within and south of the Towaliga fault; the Inner Piedmont rocks in Alabama can be subdivided into two major groups, separated by a line of lithologic discontinuity; wide zones of cataclastic rock on the southern boundary bring into juxtaposition rocks of unlike petrogenesis; and the Brevard, Towaliga, and Goat Rock fault zones may be part of a major fault system which moved deep-seated infrastructural rocks of the Inner Piedmont northwestward over shallower-seated superstructure. It is now believed that the Inner Piedmont in Alabama is a meganappe moved in pre- or early Mississippian time. This field trip examines the most diagnostic features. — GDC

07914 **Alexander, Emmit Calvin, Jr.** Noble gases, record of the early solar system [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 31, no. 6, p. 3478B, 1970.

07907 **Allen, R. O.; Haskin, L. A.; Anderson, M. R.; Müller, O.** Neutron activation analysis for 39 elements in small or precious geologic samples: Jour. Radioanal. Chemistry, v. 6, no. 1, p. 115-137, illus., tables, 1970.

A procedure has been developed for the determination of 39 elements in a single sample of rock or mineral by neutron activation analysis. After the sample has been irradiated with neutrons, it is separated chemically into 12 groups for radioassay with one NaI(Tl) and two Ge(Li) detectors. Three chemists can complete the separations and sample preparations within 7 hrs after the end of the neutron irradiation. Carrier is added and a chemical yield is determined for each element. About two months are required to obtain complete data for a particular sample, but several samples can be analyzed concurrently. In a sample of typical igneous material weighing 0.5 g, half of the elements can be determined to better than ±5 percent precision and accuracy, and fewer than a fifth with precision and accuracy poorer than ±25 percent. — Authors' abstract

00479 **Allen, S. J.** Geophysical activity in 1969: Geophysics, v. 36, no. 1, p. 189-196, tables, 1971.

Worldwide total expenditures for geophysical survey for all purposes during 1969 were up 14 percent from 1968. Expenditures for petroleum exploration were highest in the United States, followed by Africa. Canada led in mining exploration, followed by the United States, Africa, and Australia + New Zealand. The United States led in expenditures for engineering, ground-water, and construction surveys, followed by the Far East. Oceanographic surveys were mostly by the United States. Seismic work led with 93.1 percent of the total. Total crew-months of petroleum exploration were 8,052, up 4 percent from 1968. In general there was a lower cost per mile for marine data gathering and processing, together with higher productivity and more vertical and horizontal multiplicity of data points. Tables summarize activity for various purposes and by various states of the United States. — DBV

07835 **Allingham, John W.** Structural implication of aeromagnetic patterns in Mississippi-Valley type lead-zinc deposits [abs.]: Mining Eng., v. 22, no. 9, p. 52, 1970.

08037 **Alper, Allen M.** (editor). Phase diagrams, materials science and technology — V. 1, Theory, principles, and techniques of phase diagrams: New York and London, Academic Press, 358 p., illus., tables, 1970.

"Phase diagrams" is composed of three volumes. Volume 1 covers theory, principles, and techniques of forming phase diagrams. In the past five years advances have been made in using computer techniques to calculate phase diagrams and experimental methods have improved greatly. More insight has been obtained in the use of such diagrams in phase separation, sintering, diffusion, and solidification of metals and ceramic-type materials. The relation of thermodynamics to phase diagrams is developed, a short review of interpretation of phase diagrams is given, and the effect of pressure on phase equilibrium is discussed. Of the seven papers in this volume, the papers by MacChesney and Rosenberg, Yeh, and Jayaraman and Cohen are cited separately. — VSN

00463 **Alvord, Donald C.** Geologic maps of parts of the Naugatuck and Delbarton quadrangles, eastern Kentucky: U.S. Geol. Survey Geol. Quad. Map GQ-879, scale 1:24,000, sections, text, 1971.

Pennsylvanian columnar sections with descriptions of the units are included. Parts mapped cover the Kentucky portions of the quadrangles. Mineral resources of the quadrangles include coal, gas and oil, sand and gravel, clay shale, and sandstone; only coal and natural gas have been developed. The coals are high volatile A bituminous in rank. Development of natural gas has been very active in the Naugatuck quadrangle, with 21 wells completed by 1964; the Ohio Shale and Greenbrier Limestone are the main producers. The map carries structure contours on the base of Taylor coal bed for the Naugatuck quadrangle. In the Delbarton quadrangle, natural gas is produced in four wells, mostly from Ohio Shale. This map carries structure contours on the base of Pond Creek coal bed. — ESL

07996 **Am. Geological Institute.** Environmental geology — AGI short course lecture notes, Milwaukee, Wis., 1970: Washington, D. C., Am. Geol. Inst., sections paged separately, 1970.

Lecture notes for this short course on environmental geology, given in Milwaukee, Wis., November 9-10, 1970, include 10 lectures, 8 of which are cited separately, on environmental geology and related problems such as urban hydrology, earth movements, solid-waste disposal, erosion, resources, and man's relation to the geobiocoenose. Environmental geologic mapping of the Texas coastal plain is described. Curricula field trips and map exercises in environmental geology are included. — EH

07831 **American Nuclear Society; U.S. Atomic Energy Commission.** Symposium on engineering with nuclear explosives, Las Vegas, Nev., 1970, Proc. — U.S.A.E.C. CONF-700101: Springfield, Va., Clearinghouse Federal Sci. and Tech. Inf., v. 1, p. 1-858; illus., tables; v. 2, p. 859-1785, illus., tables, 1970.

This symposium reports to the Plowshare community on progress since April 1964 (date of the Third Plowshare Symposium) in use of nuclear energy for peaceful purposes. The 112 papers presented at 15 technical sessions cover all technical aspects of the Plowshare Program. Five papers from Volume 1 and 10 papers from Volume 2 are cited separately. — VSN

07839 **Amimoto, Perry Y.; Nelson, Jerome S.** Surveying reservoir leakage using waterborne electrical resistivity method: Assoc. Eng. Geologists Bull., v. 7, nos. 1-2, p. 1-9, illus., 1970.

An electrical resistivity survey conducted within a reservoir from the water surface and reservoir bottom outlined areas of probable leakage. During August and September 1968, a cable assembly was made to provide depth measurements up to 100 feet and tested in Thermalito Afterbay near Oroville, California. The electrical resistivity measurements correlated with known geology in the reservoir and with areas of high seepage outside the reservoir. — Authors' abstract

Anders, Edward. *See* Herzog, G. F. 00569

08070 **Anderson, C. D.; Sherwood, H. G.** Ore-densities of thirty-seven Canadian base-metal sulfide deposits: Canadian Jour. Earth Sci., v. 7, no. 3, p. 1012-1017, illus., tables, 1970.

Ore-density measurements were made on representative samples from thirty-seven base-metal deposits. Thirty-five of these samples were mill-feed composites and two were drill-core composites. The values obtained ranged from 2.73 g/cm^3 to 4.53 g/cm^3. The median density was 3.20 g/cm^3. — Authors' abstract

00538 **Anderson, Don L.; Sammis, Charles; Jordan, Tom.** Composition and evolution of the mantle and core: Science, v. 171, no. 3976, p. 1103-1112, illus., tables, 1971.

Seismic, ultrasonic, shock-wave, static compression, and petrologic data are used to interpret the properties of the various regions of the Earth's interior. In the light of the constraints imposed on these data, the composition and evolution of the mantle and core are discussed under the following headings: structure of the mantle and core; mineralogy of the upper mantle; the low-velocity zone; the lower mantle in terms of finite strain theory and seismic velocities; lower mantle composition; the core; origin of the mantle and core; formation of an iron-sulfur core; and possible core of Mars. — DBV

07915 **Anderson, Harold Dean.** The geochemistry and mineralogy of the Pennsylvanian clays of Mahaska County [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 31, no. 6, p. 3478B, 1970.

Anderson, M. R. *See* Allen, R. O. 07907

Anderson, T. W. *See* Terasmae, J. 07711

07727 **Anderton, Peter W.** Deformation of surface ice at a glacier confluence, Kaskawulsh Glacier, *in* Icefield Ranges Research Project, scientific results, V. 2 (V. C. Bushnell and R. H. Ragle, editors): New York, Am. Geog. Soc., *and* Montreal, Quebec, Arctic Inst. No. America, p. 59-76, illus., table, 1970.

Measurements of surface velocity at the confluence of north and central arms of this glacier show a progressive change from independent profiles across each arm towards a unified profile across the combined glacier. Strain-rate determinations near the point of confluence show that the surface ice flows through a changing stress field equivalent to simple shear with an increasing component of transverse compression. The stress field across the median line is characterized by dominant transverse compression and concomitant longitudinal extension. Surface structures are related to the stress field at the confluence. Changes in optic-axis fabrics of the ice are also correlated with changes in the stress field. Fabric symmetry probably reflects the symmetry of small-scale movements in the ice, particularly in fabrics where the optic-axis and noncrystallographic subfabrics are closely related in symmetry. — *from* Author's abstract

07695 **Andrews, J. T.** Present and postglacial rates of uplift for glaciated northern and eastern North America derived from postglacial uplift curves, *in* Symposium on recent crustal movements, Ottawa, Canada, 1969, Papers: Canadian Jour. Earth Sci., v. 7, no. 2, pt. 2, p. 703-715, illus., tables, 1970; erratum, ibid., no. 7, p. 1184, 1970.

Current rates of uplift in southeastern Hudson Bay and between Bathurst Inlet and Southhampton Island are underestimated if exponential curves are fitted solely to dated raised marine deposits without considering amount of future recovery. Rates of rebound are, instead, derived from A/t, where A is uplift in the first 1000 yr since deglaciation, and t is time since deglaciation. Maps of rates of uplift in eastern and northern North America reveal three uplift centers and show that rates of uplift declined from a maximum of 10 to 12 m/yr immediately following deglaciation to a current maximum of about 1.3 m/yr. Calculated rates agree with geologically-determined rates, radiocarbon dates, and water-level records. A map shows isochrones on the uplift rate of about 1 m/century. The rate dropped to this value about 10,000 yr

ago on the northwest and southeast coasts; the value might not be reached in southeastern Hudson Bay for another 2,000 yr. — *from* Author's abstract

Andrews, J. T. *See* Webber, P. J. 07708

00367 **Anonymous.** Alan Mara Bateman — An appreciation: Econ. Geology, v. 66, no. 1, Bateman issue, p. i, 1971.

00550 **Arur, M. G.; Mueller, Ivan I.** Latitude obeservations and the detection of continental drift: Jour. Geophys. Research, v. 76, no. 8, p. 2071-2076, table, 1971.

An attempt is made to isolate the secular element in the latitude variations and to investigate the extent these secular changes are compatible with a recent theory of continental drift. Although positive conclusions cannot be drawn because of the limited available data of large uncertainties, the calculations indicate that, while it is improbable that the observed variations in latitude are solely due to continental drift, it is likely that this is partially the case. — *from* Authors' abstract

07807 **Ash, Sidney R.** *Dinophyton*, a problematical new plant genus from the Upper Triassic of the south-western United States: Palaeontology, v. 13, pt. 4, p. 646-663, illus., table, 1970.

Dinophyton, n.gen., is based on ultimate and penultimate shoots bearing spirally arranged, outward directed, linear leaves and on associated bilaterally symmetrical organs shaped like pinwheels. The pinwheels have four arms and bear an empty cuplike structure at the center; their cuticles are very similar to those of the shoots, so it is concluded that the two organs belonged to the same plant. The pinwheel may have been seedbearing or possibly had a role in vegetative propagation. *Dinophyton* is tentatively assigned to the gymnosperms, but in the sum of its characters does not resemble any known plant. The genotype, *D. spinosus*, n.sp., has been collected from 10 localities in the Chinle Formation in east-central and north-central Arizona and west-central New Mexico and the generally equivalent Dockum Group in west-central Texas. — *from* Author's abstract

00417 **Asmussen, Loris E.** Hydrologic effects of Quarternary sediments above the marine terraces in the Georgia Coastal Plain: Southeastern Geology, v. 12, no. 3, p. 189-201, illus., 1971.

The distribution of loose unconsolidated Quaternary and Recent sediments above the 320 feet mean-sea-level that transmit shallow subsurface flow within watersheds in the Georgia Coastal Plain is explained. The sediments have the characteristic depositional pattern of eolian and fluvial processes; distribution was controlled by source area, pre-Quaternary stream network, and prevailing winds. The depositional pattern acts as a major control on phreatic ground-water movement and surface runoff, and must be understood for prediction of hydrologic performance of the watersheds. — VSN

Aumento, F. *See* Irving, E. 07702

07721 **Aumento, F.** Improved positioning of dredges on the sea floor: Canadian Jour. Earth Sci., v. 7, no. 2, pt. 1, p. 534-539, illus., 1970.

The locations from which dredges obtain samples of rocks on the sea floor can be computed with considerable accuracy using a system of moored radar transponder buoys, a precision timed pinger, a bathykymograph, and a load cell. — Author's abstract

07990 **Austin, G. S.** Deep stratigraphic test well near Hollandale, Minnesota: Minnesota Geol. Survey Rept. Inv. 12, 52 p., illus., tables, 1970.

The Hollandale No. 1 deep stratigraphic test well in Freeborn County, Minnesota was drilled in Precambrian to Devonian rocks in search for reservoirs suitable for underground storage of natural gas. The porous Ordovician St. Peter Sandstone and the

Cambrian Mt. Simon Sandstone are potential reservoir rocks. The Ordovician Decorah Shale overlying the St. Peter is probably the most suitable cap rock although restricted geographically and generally lying relatively near the surface. The Eau Claire Formation above the Mt. Simon is also considered as possible cap rock but is composed of shales interbedded with sandstone and is vertically permeable. Recurrent lithotypes of the Paleozoic rocks are quartz arenite, poorly sorted lithotype with strata of clastic particles or arenaceous carbonate, shale or argillaceous sandstone, and carbonate rock. — *from* Author's abstract

Baadsgaard, H. *See* Koster, F. 08063

Baerreis, David A. *See* Bryson, Reid A. 08045

00433 **Bailey, Robert V.** Physical characteristics of Wyoming roll-type uranium deposits [abs]: Econ. Geology, v. 66, no. 1, p. 203-204, 1971.

07806 **Baker, Simon; Dill, Henry W., Jr.** (compiler). The look of our land, an airphoto atlas of the rural United States — North-central: U.S. Dept. Agriculture, Agriculture Handb. 384, 64 p., illus., 1970.

Airphotos in this handbook were selected to show characteristics of the land and land use in 28 resource areas in three regions comprising all or parts of 14 North-Central States. A brief description of land use, climate, soils, and topography are given for each area. Two facing pages are devoted to each land resource area and include a stereopair of a part of the larger area for terrain study and an aerial photographic index sheet on which the stereopair can be located. — VSN

00502 **Ballard, Robert D.; Uchupi, Elazar.** Geological observations of the Miami Terrace from the submersible *Ben Franklin*: Marine Tech. Soc. Jour., v. 5, no. 2, p. 43-48, illus., table, 1971.

Observations made from the submersible *Ben Franklin* have been used to complement earlier investigations of the Miami Terrace. The terrace is divided into four geomorphic provinces: a Pliocene-Quaternary wedge of prograding sediments, a central irregular platform covered by a continuous pavement of phosphorite, an outer terrace ridge province also covered with phosphorite, and an outer terrace slope of sediments and large phosphorite covered talus blocks. Visual observations, bottom samples, and current measurements in each of these provinces by the submersible are compared with previously obtained results based on conventional techniques of seismic profiling, echo-sounding, and bottom photography. — *from* Authors' abstract

Bamber, E. W. *See* Taylor, G. C. 07897

07977 **Bamber, E. W.** (and others). Biochronology — Standard of Phanerozoic time, Chap. 11 *in* Geology and economic minerals of Canada: Canada Geol. Survey Econ. Geology Rept. 1 (5th edition), p. 591-674, illus., tables, 1970.

This chapter deals with the paleontological basis for correlation within Phanerozoic rocks of Canada which are named on geotectonic correlation charts (Charts 1-4 in the folio accompanying this volume). Standards are worldwide for the Mesozoic and Tertiary and for both North America and Europe for the Paleozoic. The paleontology of each period is discussed, and the guide fossils or faunal zonation are shown in tables in relation to the standard sequence. Sections of this chapter, written by different authors, include: Cambrian faunas, Ordovician and Silurian faunas, Devonian faunas, Carboniferous and Permian faunas, marine Triassic faunas, marine Jurassic faunas, Cretaceous macrofaunas, paleobotany and marine Pleistocene faunas. — EH

00496 **Bandy, Orville L.; Ingle, James C., Jr.; Wright, Ramil C.** *Globorotaloides suteri* Bolli subspecies *relizensis* n.subsp.: Jour. Foraminiferal Research, v. 1, no. 1, p. 15-16, illus., 1971.

Globorotaloides suteri relizensis, a new subspecies of *G. suteri* Bolli, 1957, is described, and types illustrated, from the lower Relizian Stage (lower middle

Miocene) of California in the Salinas Valley near Adelaida, San Luis Obispo County. It differs from the nominotype in lacking the characteristic lip and in usually lacking a bulla. Its stratigraphic range seems to be upper Saucesian (upper lower Miocene) through lower Relizian, and the unique character of the form may make it one of the better planktonic indices for that interval. — VMJ

07965 **Banerjee, Subir K.** Reliability of paleomagnetic data from basalts: Comments Earth Sci. — Geophysics, v. 1, no. 2, p. 43-46, illus., 1970.

The problem of differentiation between chemical remanent and thermoremanent magnetizations in basalts is considered. Three things are suggested to insure reliable data from oxidized basalt: accept data only from those oxidized basalts which show presence of pseudobrookite, a sign that oxidation temperature was higher than 600°C, and study experimentally acquisition and demagnetization characteristics of CRM and TRM in basalts; even if the NRM is a CRM, such identification could lead to calculation of a correction factor for the radioactive age determined from micas in basalt. — VSN

Bannatyne, B. B. *See* Klassen, R. W. 07862

07759 **Barlow, James A., Jr.; Haun, John D.** Regional stratigraphy of Frontier Formation and relation to Salt Creek field, Wyoming, *in* Geology of giant petroleum fields — Symposium, AAPG, 53d Ann. Mtg., Oklahoma City, Okla., 1968: Am. Assoc. Petroleum Geologists Mem. 14, p. 147-157, illus., table, 1970.

Most oil production from Salt Creek field, Natrona County, is from the second Frontier sandstone, one of many such bodies interbedded with marine shale in the lower Upper Cretaceous of this region. The stratigraphic interval between Mowry Shale and Niobrara Formation, containing Frontier and equivalent formations, is over 1,000 feet thick in Wyoming and southeastern Montana. Sand was transported by river systems into deltaic complexes or lobate concentrations along margins of an early Late Cretaceous sea; the second Frontier sandstone, several miles wide, 60 mi long, and 100 feet thick, was an offshore bar. Salt Creek anticline is in an area of excellent sandstone development, with stratigraphic traps where oil accumulated before secondary migration into present structural positions. Other Frontier sandstone bodies with stratigraphically trapped oil are not draped over an obvious anticline. — *from* Authors' abstract

07691 **Barnett, D. M.** An amendment and extension of tide gauge data analysis for Churchill, Manitoba, *in* Symposium on recent crustal movements, Ottawa, Canada, 1969, Papers: Canadian Jour. Earth Sci., v. 7, no. 2, pt. 2, p. 626-627, table, 1970.

An amended rate of land emergence at Churchill, Manitoba is given as 1.3 ft (39 cm) per century with 95 percent confidence limits of 1.68 ft and 0.85 ft (51.2 and 25.9 cm). It is based on a polynomial regression analysis of tide gauge data for 1940-1968 using the linear function as the most satisfactory. — Author's abstract

00426 **Barnett, Stockton G.** Biometric determination of the evolution of *Spathognathodus remscheidensis*—A method for precise intrabasinal time correlations in the northern Appalachians: Jour. Paleontology, v. 45, no. 2, p. 274-300, illus., tables 1971.

Environmental analysis of the cosmopolitan conodont species S. remscheidensis Ziegler in upper Cayugan and Helderbergian strata of northern New Jersey and southeastern New York showed that the species is most abundant near the reef and is less abundant seaward. Sample populations of the species from 11 successive horizons at two localities were studied biometrically to determine evolutionary changes, using univariate and bivariate analysis on six characters unrelated to size, and two characters related to size, respectively. Some characters are shown to be related to environment, while others are evolutionary and can be used for precise correlation in New Jersey and New York. — JWH

00561 **Barr, K. G.** Crustal refraction experiment — Yellowknife 1966: Jour. Geophys. Research, v. 76, no. 8, p. 1929-1947, illus., tables, 1971.

A crustal refraction experiment was carried out around Yellowknife, Northwest Territories, in 1966. The records were unusually simple, and nearly all arrivals could be explained by a shallow surface layer (3.5 ± 1.2 km at 5.5 kmps) overlying a uniform crust (6.1 ± 0.04 kmps). No significant difference was found between the crustal thicknesses under the Slave and Churchill Precambrian provinces, but they are separated by a narrow belt corresponding to the east arm of Great Slave Lake, under which the crust is about 4 km thick. The interpretation is supported by P_n. Upper mantle velocity west of the Precambrian margin (8.23 ± 0.04 kmps) was higher than that east of the margin (8.10 ± 0.03 kmps); this may be related to an orogenic belt parallel to, but west of, the margin in late Aphebian time. — *from* Author's abstract

07724 **Barringer, A. R.; Davies, J. H.** Experimental results in the remote sensing of gases from high altitudes, *in* Earth Resources Aircraft Program, status review, 2d Ann., Houston, Tex., 1969 — V. 2, Agriculture, Forestry, and sensor studies: Houston, Tex., U.S. Natl. Aeronautics and Space Admin., Manned Spacecraft Center, p. 34-1—34-31, illus., [1970?].

A brief history of correlation spectroscopy is given, and the continuing progress in experimental and theoretical development of techniques for remote sensing of trace gases by optical correlation methods is reviewed. Good results have been obtained in terms of monitoring patterns of pollution and tracking plumes, and methods are being developed for improving absolute accuracy of measurements. Prospects are reviewed for ultimate development of scanning multigas monitors for satellite platforms and their potential role in measuring buildup of atmospheric pollution on a worldwide scale. Experiments are described which relate to the feasibility of remote gas detection in trace amounts as an aid to natural resources exploration and survey. — *from* Authors' abstract

07755 **Barss, D. L.; Copland, A. B.; Ritchie, W. D.** Geology of Middle Devonian reefs, Rainbow area, Alberta, Canada, *in* Geology of giant petroleum fields — Symposium, AAPG, 53d Ann. Mtg., Oklahoma City, Okla., 1968: Am. Assoc. Petroleum Geologists Mem. 14, p. 19-49, illus., 1970.

Pre-Middle and Middle Devonian, basal cyclic redbeds of the Elk Point Group, deposited in a shallow epeirogenic sea — the incipient Black Creek basin — are overlain by the dark carbonate lower member of Keg River Formation, with "lime-mud" mounds near the top believed to be loci of reef-builders in the 50-ft-thick crinoidal upper member; rapidly grown Rainbow Member reef pinnacles and atoll forms have vertical relief up to 820 feet. Fourteen lithofacies represent six depositional environments. The Shekilie barrier-reef complex across northwestern Alberta, and regional tectonics, altered late Elk Point sedimentation by preventing free flow of normal marine waters into the basin. The Black Creek salt member and minor Muskeg anhydrites buried the Rainbow reefs, except in the Shekilie complex, providing a seal for hydrocarbon entrapment. Estimated oil reserves in Rainbow and Rainbow South fields exceed 1.2 billion bbl and 165 million bbl, respectively. — GDC

Bartlett, Grant A. *See* King, Lewis H. 07674

07704 **Bartlett, Grant A.; Greggs, Robert G.** The Mid-Atlantic Ridge near 45°00′ north — [Pt.] 8, Carbonate lithification on oceanic ridges and seamounts: Canadian Jour. Earth Sci., v. 7, no. 2, pt. 1, p. 257-267, illus., 1970.

Deep sea carbonate lithification and the interbedding of carbonate and ferromanganese are common processes on oceanic ridges and seamounts. Temperature and salinity changes caused by climatic fluctuations or heat emanations and manganese substitution for calcium in the calcite lattice along these ridges are believed to be responsible for these inorganic processes. Lithification and solution of the carbonate take place at the sediment-water interface and can occur in ocean depths of at least 3000 m. — Authors' abstract

07705 **Bartlett, Grant A.; Greggs, Robert G.** A reinterpretation of stylolitic solution surfaces deduced from carbonate cores from San Pablo Seamount and the Mid-Atlantic Ridge: Canadian Jour. Earth Sci., v. 7, no. 2, pt. 1, p. 274-279, illus., 1970.

Processes associated with deep sea carbonate lithification suggest an alternative mechanism, other than pressure-solution, for the formation of stylolites. Stylolites may also be formed by submarine solutional erosion following lithification, oxidation of the eroded surface, and renewal of carbonate deposition. This process is responsible for removing significant quantities of carbonate sediment in the marine environment without exposure to subaerial agencies. — Authors' abstract

Barton, Paul B., Jr. *See* Bethke, Philip M. 00377

07720 **Basham, P. W.** Seismic magnitudes of high-yield underground explosions: Canadian Jour. Earth Sci., v. 7, no. 2, pt. 1, p. 531-534, illus., 1970.

The seismic magnitude of the October 2, 1969 high-yield underground explosion (Milrow) in the Aleutian Islands, when compared to the smaller 1965 Long Shot explosion, suggests that in the yield range near 1 megaton the yield exponent in the amplitude-yield relationship is significantly less than the value of unity which applies for yields less than 100 kilotons. The lower exponent is shown to apply equally well to Nevada Test Site high-yield explosions. A general Aleutian site effect is observed to produce seismic magnitudes for Aleutian explosions that are about m0.3 larger than those of similar-yield explosions at the Nevada Test Site. — Author's abstract

00566 **Bass, Manuel N.** Montmorillonite and serpentine in Orgueil meteorite: Geochim. et Cosmochim. Acta, v. 35, no. 2, p. 139-147, illus., tables, 1971.

Montmorillonite and serpentine are present in Orgueil meteorite and constitute the bulk of its crystalline material. Basal d-values obtained by X-ray diffraction methods suggest that serpentine in C2 meteorites is better crystallized than that in Orgueil. Water has been picked up by montmorillonite and $MgSO_4$ since Orgueil fell. The montmorillonite may also have picked up polar organic compounds. — Author's abstract

00484 **Bassett, I. J.; Crompton, C. W.** Pollen morphology of the family Caprifoliaceae in Canada [with French abs.]: Pollen et Spores, v. 12, no. 3, p. 365-380, illus., 1970 [1971].

Pollen grains of 25 species of the honeysuckle family indigenous to Canada are described in detail, and a key to their identification is presented, to aid the palynologist in identifying fossil pollen of this family that is commonly found in Quatnernary postglacial deposits in Canada. Based on present distribution, abundance, and habitat, the species most likely to be represented in peat and sedimentary deposits are: *Linnaea borealis longiflora, Diervilla lonicera, Lonicera canadensis, L. oblongifolia, L. villosa colonis, Viburnum cassinoides, V. lentago, V. opulus americana, V. edule, Sambucus* species. Pollen of the above genera can be separated by reliable morphological characters, but it is difficult to distinguish between closely related species. Correlation between pollen size and chromosome number is significant in some species-groups. — VMJ

Batten, Roger L. *See* Dott, Robert H., Jr. 00587

Battles, Richard F. *See* Comm. on Subsoils of Boston. 07865

00583 **Bayne, Charles K.; Franks, Paul C.; Ives, William, Jr.** Geology and ground-water resources of Ellsworth County, Central Kansas: Kansas Geol. Survey Bull. 201, 84 p., illus., tables, hydrogeol. map, 1971.

Ellsworth County is in the Dissected High Plains section of the Great Plains physiographic province. The oldest rock that crops out, Ninnescah Shale of Early Permian age, is overlain unconformably by rocks of Early to Late Cretaceous age. The Upper-Lower Cretaceous boundary may lie in the lower part of the Dakota Formation which occurs between the Kiowa Formation, considered Early Cretaceous, and the Graneros Shale, considered Late Cretaceous. Phocene rocks in the county consist of remnants of soil caliche. Pleistocene rocks unconformably overlie Permian and Cretaceous rocks in the valleys and parts of the upland area. The Dakota Formation

and the Pleistocene deposits in the valleys are the most important aquifers. Yields of wells may be more than 250 gpm in some areas. The water is suitable for most uses but varies from place to place. — *from* Authors' abstract

Beard, Michael E. *See* Knochenmus, Darwin D. 00590

00449 **Beaton, Neil S.** Memorial to Max Hans Frohberg [1901-1970]: Geol. Assoc. Canada Proc., v. 23, p. 79-80, portrait, 1971.

07966 **Beck, A. E.** Non-equivalence of oceanic and continental heat flows and other geothermal problems: Comments Earth Sci. — Geophysics, v. 1, no. 2, p. 29-35, 1970.

Heat flow data indicate little difference between oceanic and continental measurements. It is pointed out here that there may be a systematic effect which, when allowed for, would cause a divergence of mean oceanic and continental heat flow values. Two types of potential error are discussed: long-term global variations in climate, such as those accompanying advance and retreat of glaciers, could be a major source of error for continental values, and instrumental errors in needle-probe measurements of conductivity in oceanic sediments. The instrumental errors are probably not as great as the effect of climate. Other more local sources of error are discussed also. Useful aspects of heat-flow data with regard to these error effects are discussed briefly. — VSN

Beck, K. C. *See* Windom, H. L. 00415

Beetem, W. A. *See* Grove, D. B. 00451

07995 **Bell, Curtis C.; Forward, Robert L.; Williams, Harvell P.** Simulated terrain mapping with the rotating gravity gradiometer, *in* Advances in dynamic gravimetry (Wilbur T. Kattner, editor) — Symposium, Fort Worth, Texas, 1970, Proc.: Pittsburgh, Pa., Instrument Society of America, p. 115-129, illus., 1970.

Results are presented of an experimental simulation of the gravity gradient profile expected from a rotating gravity gradiometer passing over terrane with subsurface density fluctuations. A scaled-down simplified terrane model with density variations similar to those expected in real terrane was moved past a laboratory version of the rotating gravity gradiometer, and sensor output was plotted as a function of the relative position of the sensor with respect to simulated mass distribution. The resultant gravity gradient profile is compared with that predicted by a computer program. The situation simulated was that of a lunar spacecraft at 30 km altitude orbiting over mascon structures, but the simulation could apply to an aircraft at 3 km altitude flying over large geologic structures many km down, or at 300 m looking at small local near-surface structures. — *from* Authors' abstract

07803 **Belousov, I. M.** O nekotorykh geomorfologicheskikh osobennostyakh yuzhnoy chasti Meksikanskogo zaliva i prikubinskogo rayona [Some geomorphological features of the southern part of the Gulf of Mexico and the Cuban region (with English and Spanish abs.)], *in* Okeanologicheskiye issledovaniya, Sbornik statey, no. 20 — Rezul'taty issledovaniy po mezhdunarodnym geofizicheskim proyektam: Moscow, Izdatel'stvo "Nauka," p. 11-21, illus., 1970.

The bottom relief of the Gulf of Mexico is described on the basis of data obtained on the 6th, 7th, and 8th cruises of the Soviet research ship *Akademik Kovalevskiy*. The new data made it possible to compile a geomorphological map of the southern part of the gulf where dissected relief is probably of tectonic origin. Off the southern coast of Cuba a bank was discovered at a depth of 31 m. On the northwestern and northeastern slopes of Cuba are observed many narrow, deep crevasses which are probably canyons of tectonic origin. — *from* English abstract

Belyea, H. R. *See* Douglas, R. J. W. 07974

Belyea, H. R. *See* Little, H. W. 07975

00438 **Bennett, G.; Innes, D. G.** Chambers Township, District of Nipissing: Ontario Dept. Mines and Northern Affairs Prelim. Map P.666 (Geol. Ser.), scale 1 in. to 1/4 mi., text, 1971.

Archean metavolcanics and metasediments underlie the area, and the former are intruded by varied igneous rocks. Significant fault movements are indicated. Iron is being produced at one mine, and three other possible orebodies exist. Areas of sulfide mineralization are being explored. — ESL

Bentley, Robert D. *See* Wampler, J. Marion. 07734

Bentley, Robert D. *See* Alabama Geological Society. 07735

Bermudez, Pedro J. *See* Seiglie, George A. 00517

Berry, Michael J. *See* Hirasawa, Tomowo. 00592

00423 **Berry, William B. N.; Marshall, Frederick C.** Late Ordovician graptolites from the Maquoketa Formation in eastern Missouri: Jour. Paleontology, v. 45, no. 2, p. 253-257, illus., 1971.

Climacograptus mississippiensis Ruedeman and *Orthograptus truncatus* var. *socialis* (Lapworth) are described from a higher and a lower stratigraphic interval respectively in an exposure of the Maquoketa Formation near Barnhart, south of St. Louis, Mo. The graptolites indicate a latest Ordovician (graptolite Zone 15) age and suggest correlation with the uppermost Maquoketa in Iowa and with the Richmond or upper Maysville of the Cincinnati area. The formation in eastern Missouri is thinner and more dominantly shale than it is to the north or east. — *from* Authors' abstract

00581 **Berry, William B. N.; Takagi, Robert S.** Electron microscope study of a *Diplograptus* species: Lethaia, v. 4, no. 1, p. 1-13, illus., 1971.

Specimens of *Diplograptus* sp. from the late Middle Ordovician Lebanon Limestone in central Tennessee were isolated from the matrix and examined with transmission electron microscopes at 60 and 650 kv. The fine structure of the fusellar layer in the metasicula and thecae is a closely woven mesh formed from fibers. The cortical layer has two sublayers, one a mesh like that of the fusellar layer, the other formed from two sets of long fibers oriented to each other at moderate to high angles. The prosicula outer wall is a loosely woven mesh of fibers 0.080-0.165 μ diam. The spiral thread appears as a band of interwoven fibers; the longitudinal rod is a bundle of long fibers. Prosicula microstructures are significantly different from those in an *Orthograptus* of the *O. quadrimucronatus* group from the Maquoketa Formation, Iowa (Berry and Takagi, 1970). — *from* Authors' abstract

07775 **Berryhill, Henry L., Jr.** Remote sensing techniques as applied to coastal sedimentation, south Texas, *in* Earth Resources Aircraft Program, V. 1: Houston, Tex., U.S. Natl. Aeronautics and Space Admin., Manned Spacecraft Center, p. 6-1—6-15, illus., [1970,].

Remote-sensing observations of the barrier bar coastline of South Texas were started following Hurricane Beulah in 1967. Aspects of the study discussed here are those which show best the comparison of remote-sensing techniques and demonstrate the value of sequential monitoring in coastal marine investigations. Aspects are: sediment movement, current patterns, water penetration and clarity of bottom features, and bay and lagoon flushing as indicated by infrared imagery. — VSN

00377 **Bethke, Philip M.; Barton, Paul B., Jr.** Distribution of some minor elements between coexisting sulfide minerals: Econ. Geology, v. 66, no. 1, Bateman issue, p. 140-163, illus., tables, 1971.

Distribution coefficients for cadmium, manganese, and selenium have been determined experimentally for the pair sphalerite-galena and for selenium between galena and chalcopyrite. They vary sufficiently with temperature to permit reasonably precise temperature estimates, potentially within the range ± 15°-20°C down to

200°C. Cd and Mn are concentrated in sphalerite or wurtzite relative to galena; concentration of selenium is most in galena and least in sphalerite, with chalcopyrite similar to sphalerite. Applications to naturally occurring mineral are complicated by difficulty of ascertaining that samples represent pairs that equilibrated when deposited, and have not changed since. Sample-purity requirements are stringent, particularly for depleted phase. — WSW

07680 **Bhattacharji, S.; Nehru, C. E.** Igneous structures and mechanism of emplacement of Mount Johnson, a Monteregian intrusion, Quebec — Discussion [of paper by A. R. Philpotts, 1968]: Canadian Jour. Earth Sci., v. 7, no. 1, p. 191-194, illus., table, 1970.

The original paper appeared in ibid., v. 5, no. 5, p. 1131-1137, 1968; Abs. North American Geology, May 1969.

07885 **Bieberman, Robert A.** San Juan Basin — Synonym for energy: Interstate Oil Compact Comm. Comm. Bull., v. 12, no. 2, p. 1-6, illus., 1970.

The San Juan Basin, in northwestern New Mexico and adjacent parts of southwestern Colorado and northeastern Arizona, is the second largest gas producer and leading uranium producer in the United States, the site of the largest coal mine in the Western Hemisphere, and the location of the largest electric generating facility west of the Mississippi River, in other words, an enormous source of energy. Devonian, Mississippian, Pennsylvanian, Jurassic and Cretaceous rocks are the oil and gas producers, Cretaceous rocks the source of coal and electricity, and Jurassic rocks the source of uranium. This article reviews the history of exploration for and production of these energy sources. — EH

Bielenstein, H. U. *See* Eisbacher, G. H. 07686

Biggs, Charles A. *See* McGregor, Alexander A. 07758

00574 **Black, David C.** Trapped neon-argon isotopic correlations in gas rich meteorites and carbonaceous chondrites: Geochim. et Cosmochim. Acta, v. 35, no. 2, p. 230-235, illus., table, 1971.

Trapped argon in gas-rich meteorites and carbonaceous chondrites is found to vary in isotopic composition. The variations correlate with associated variations in the trapped Ne-20/Ne-22 ratio. The correlation found here, as well as those observed ealier for trapped helium and neon, indicate a complex but strongly coupled history for trapped light rare gases in meteorites. — Author's abstract

00488 **Blander, Milton.** The contstrained equilibrium theory — Sulphide phases in meteorites: Geochim. et Cosmochim. Acta, v. 35, no. 1, p. 61-76, illus., tables, 1971.

The constraints imposed by nucleation kinetics are taken into account in calculations of the condensation of sulfide phases from a gas of solar composition. Troilite will condense from a gas supersaturated with respect to metallic iron at much higher temperatures than from a gas at equilibrium with iron. In a solar gas at relatively high pressures, liquid troilite is condensed. At lower pressures, solid troilite is condensed. The solid does not accommodate significant amounts of some sulfides in solid solution at activities less than unity and some chalcophilic elements will not tend to co-condense. On the other hand, liquid troilite can accommodate significant concentrations of sulfides in solution at activities less than unity and other chalcophile elements will co-condense. Some implications and predictions concerning genesis of sulfide and metal phases which result from out calculations will be discussed. — *from* Author's abstract

07797 **Bleuer, N. K.** Geologic considerations in planning solid-waste disposal sites in Indiana — Environmental study No. 1: Indiana Geol. Survey Spec. Rept. 5, 7 p., illus., 1970.

Geologic factors applicable to the selection of sanitary landfill sites in Indiana include the nature of ground-water supplies, the thickness of glacial drift over bedrock aquifers, and the character and sequence of the surficial or bedrock materials and the aquifers therein. Types of problems which could be encountered in Indiana are discussed, and a map showing geologic limitations for solid-waste disposal sites in the state is given. — EH

Blinn, John C., 3d. *See* Chapman, Peter. 07793

08085 **Blinn, John C., 3d.** Microwave studies and instrumentation for the Earth Resources Program, *in* Earth Resources Aircraft Program, status review, 2d Ann., Houston, Tex., 1969 — V. 2, Agriculture, Forestry, and sensor studies: Houston, Tex., U.S. Natl. Aeronautics and Space Admin., Manned Spacecraft Center, p. 30-1—30-3, [1970?].

The Jet Propulsion Laboratory at Pasadena, Calif. has supported the Earth Resources Program in 1968 in three areas: groundbased microwave radiometry, airborne microwave radiometry, and radar. The programs are outlined very briefly. — VSN

07698 **Bloom, A. L.** Panel discussion [on isostasy], *in* Symposium on recent crustal movements, Ottawa, Canada, 1969, Papers: Canadian Jour. Earth Sci., v. 7, no. 2, pt. 2, p. 731-733, illus., 1970.

Attention is called to geological factors which are often not taken into account by those who prepare mathematical models of earth phenomena. Under glacial load compressional stress in the crust, rather than tensile stress, would result. The latter is implied by a theoretical flat-plate model of a loaded elastic crust over a planar viscous substratum. The former would result from scale model theory. The displacement of rock masses from beneath a glacially-depressed area cannot be accomplished as assumed by the theoreticians that the load has been added to the crust rather than transferred from one area to another. The proposed forebulges cannot be constructed as there is not sufficient crustal or mantle rock available to build them. — HRC

00529 **Bogdanov, N. A.** Voprosy tektoniki Beringova morya i yego obramleniya (O simpoziume po geologii i geofizike Beringova morya, sostoyavshemsya v Ferbenkse, Alyaska, SShA) [Problems of the tectonics of the Bering Sea and its framework (on the symposium on the geology and geophysics of the symposium on the geology and geophysics of the Bering Sea, held in Fairbanks, Alaska, U.S.A.)]: Geotektonika, no. 1, p. 125-127, 1971.

This is a report on the symposium in question, organized by the University of Alaska and held June 24-July 1, 1970, followed by field excursions in various parts of Alaska. About 150 scientists from the United States and 25 from the U.S.S.R., Canada, and Japan participated. The scientific sessions were devoted to three problems: the origin and geology of the deep-sea basin of the Bering Sea and adjacent territories; geologic varieties formed at great depths under high pressure; and permafrost, conditions of formation of ice in the ocean, and regularities of its drift. The content of each of the papers presented is mentioned briefly. — DBV

00570 **Bonatti, Enrico; Fisher, D. E.; Joensuu, Olva; Rydell, H. S.** Postdepositional mobility of some transition elements, phosphorus, uranium and thorium in deep sea sediments: Geochim. et Cosmochim. Acta, v. 35, no. 2, p. 189-201, illus., tables, 1971.

Deep-sea hemipelagic sediments from the east Pacific show an oxidized upper zone of variable thickness and a reduced zone below. A detailed geochemical study of a core from this region is reported here. Postdepositional mobility can explain the enrichment in certain elements in the upper zone and in others in the lower. Some of the consequences of depositional mobility of elements in deep-sea sediments are: (1) average element content, generally estimated from samples from the upper zone, may be in error (over estimation of Mn, Ni, Co, P, and La and underestimation of V, Cr, and U); (2) postdepositional redistribution of U may affect Th-230/Th-232 and

Th-230/Pa-231 age determinations on sediments; (3) some geographic variations in the composition of Fe-Mn nodules can be explained by postdepositional mobility of Mn, Ni, and Co. — DBV

07789 **Bonet, F.; Riva-Palacio, E.** *Bonetocardiella cardiiformis* en el Maestrichtiano de Mexico [*Bonetocardiella cardiiformis* in the Maestrichtian of Mexico]: Inst. Mexicano Petróleo Rev., v. 2, no. 4, p. 72-75, illus., table, 1970.

Bonetocardiella cardiiformis has been found in limestones at various localities in Mexico. This microfossil, whose taxonomic position is uncertain, was found in the Maestrichtian, although its possible presence in the Campanian cannot be excluded. The species is described in detail and compared with *B. conoidea* and *B. betica*. The species was originally described as *Stomiosphaera cardiiformis* from Cuba. Dufour (1968) established the genus *Bonetocardiella*, with *Stomiosphaera conoidea* as the genotype, and including *B. betica* and *B. cardiiformis*. The new genus is useful, but complete revision is needed to determine other species which should be included. — EH

Bonnet, C. W. *See* Gabrysch, R. K. 08031

00472 **Boore, David M.; Aki, Keiiti; Todd, Terry.** A two-dimensional moving dislocation model for a strike-slip fault: Seismol. Soc. America Bull., v. 61, no. 1, p. 177-194, illus., table, 1971.

For a propagating vertical strike-slip fault extending to the Earth's surface, it has been suggested that near-field motions may be similar to those from uniformly-gliding-edge dislocations. The theory of these dislocations in uniform motion leads to a simple, convenient relation between perpendicular and parallel components of motion at the fault's surface; examples are given to illustrate this relation between the horizontal components. Step-function-like parallel motions result in pulse-like perpendicular displacements. For a given parallel displacement the amplitude of the pulse depends on ratios of rupture to shear-wave velocity, and on S- to P-wave velocity. Increasing either of these ratios leads to increased pulse-amplitude. The dislocation model is applied to near-field observations of the Parkfield earthquake; the estimated total fault offset is within the range of those based on the more detailed models of Aki (1968) and Haskell (1969). — DBV

Borbereky, Horst. *See* Comm. on Subsoils of Boston. 07865

07851 **Borchardt, G. A.; Hoagland, G. W.; Schmitt, R. A.** Spectra — A computer program for gamma-ray analysis: Jour. Radioanal. Chemistry, v. 6, no. 1, p. 241-271, tables, 1970.

A computer program in FORTRAN IV is presented for the determination of peak location, peak areas and elemental abundances of γ-ray spectra. — Authors' abstract

07984 **Borg, I. Y.** Microfracturing in postshot Gasbuggy core GB-3: California Univ., Livermore, Lawrence Radiation Lab. Rept. UCRL-50893, 16 p., illus., tables, 1970.

Microfracturing in shocked rock of the Ojo Alamo, Picture Cliffs, and Lewis formations, examined microscopically in core samples, shows little correlation with distance from shot point, but does show qualitative correlation with premeability measurements on the same cores. Fractures are short-lived in the sandstones and terminate within individual grains or die out in the semiductile cementing clays or micas. Finer-grained sediments show extensive bedding dilation; it is questionable whether those in shales would increase permeability. Maximum stresses indicated are somewhat below yield strengths of the rocks in triaxial tests. Shock effects in brittle granodiorite and in semibrittle Gasbuggy rocks at the same peak radial stresses indicate matrix fracturing many times greater in the granodiorite, and hence the important role of weak cementing minerals in Gasbuggy rocks in determining mode of yielding. — *from* Author's abstract

Bos, C. *See* Matwe, L. 07893

07969 **Bostock, H. S.** Physiographic subdivisions of Canada, Chap. 2 *in* Geology and economic minerals of Canada: Canada Geol. Survey Econ. Geology Rept. 1 (5th edition), p. 9-30, illus., 1970.

Physiographically and geologically Canada consists of the Shield, which is a core of massive Precambrian crystalline rocks, and the Borderlands surrounding it, of younger, mainly stratified rocks. Both large areas are divided into physiographic regions comprising many smaller units. The Shield, made up of four regions, is a generally flat erosion surface, uniform in terrain and geologic structure, with a few eroded monadnocks and ranges of hills. The physiographic provinces of the Borderlands vary greatly. The relatively rugged Innuitan Region, Arctic Coastal Plain and Continental Shelf and Arctic Lowlands are in the north, the Interior Plains and Cordilleran Region in the west, and the St. Lawrence Lowlands, well-developed peneplain of the Appalachian Region and the Atlantic Coastal Shelf in the east. The geologic and terrain characteristics and drainage patterns are described for each region and subregion. — EH

00467 **Boucher, Gary; Maline, Stephen D.; Homuth, E. Fred.** Strain effects of nuclear explosions in Nevada: Seismol. Soc. America Bull., v. 61, no. 1, p. 55-64, illus., 1971.

The JORUM and HANDLEY nuclear explosions produced static strain effects of a few parts in 10^9 at Round Mountain, Nevada, which did not decay within the first few hours after the explosions. In both cases the strain offsets were not consistent with the assumption of a pure compressive source of strain. The record is interpreted as supporting the hypothesis that the strain changes are tectonic in origin, and the explosion initiates the strain release. Small offsets were observed for three smaller explosions out of a total of 13 studied. The relationship between body-wave magnitude m_b and maximum dynamic strains at Round Mountain may be described by the empirical equation $\log S = -13.4 + 1.10m_b$. — DBV

Bourque, Pierre-Andre. *See* Lesperance, Pierre J. 00420

Boyd, Donald W. *See* Newell, Norman D. 07866

07916 **Boyer, Paul Slayton.** Actuopaleontology of the larger invertebrates of the coast of Louisiana [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 31, no. 6, p. 3592B-3593B, 1970.

00442 **Boyle, R. W.** Thomas Sterry Hunt (1826-1892) — Canada's first geochemist, *in* History of Canadian Geologists: Geol. Assoc. Canada Proc., v. 23, p. 15-17, portrait, 1971.

Boyle, R. W. *See* Land, A. H. 07972

00512 **Bray, J. Roger.** Solar-climate relationships in the post-Pleistocene: Science, v. 171, no. 3977, p. 1242-1243, 1971.

The most conspicuous climatic aberration of the past two millennia was the temperature decline and glacial advance of the A.D. 1550 to 1900 period. This temperature decline has been correlated with an interval of lower solar activity, and there is evidence from both the post-Pleistocene glacial record and from oxygen-18 analysis that such an interval has recurred at cyclic periods of around 2400 to 2600 years. — Author's abstract

Brennan, J. A. *See* Taylor, P. T. 00597

Brennan, Peter. *See* Chapman, Peter. 07793

00571 **Brett, Robin.** The Earth's core — Speculations on its chemical equilibrium with the mantle: Geochim. et Cosmochim. Acta, v. 35, no. 2, p. 203-221, tables, 1971.

A review of the literature indicates that a reasonable estimate of the composition of the Earth's core is iron with Ni_{0-5}, Si_{10-25} (wt 0/0). One wt percent each of Mn, P, and Cr might also be present. A core of this composition was probably in chemical

equilibrium with the mantle at the time of core formation. The anomalously high abundance of Cu in the upper mantle can be explained by enrichment through partial melting. Volcanic gases are not likely to represent the composition of volatile elements at the core-mantle boundary, and hence cannot be regarded as valid criteria of disequilibrium at the boundary. Available data on reaction kinetics suggest that a disequilibrium state would be unlikely during core formation. — *from* Author's abstract

00594 **Brew, David A.** Mississippian stratigraphy of the Diamond Peak area, Eureka County, Nevada; *with a section on* The Biostratigraphy and age of the Carboniferous formations *by* Mackenzie Gordon, Jr.: U.S. Geol. Survey Prof. Paper 661, 84 p., illus., tables, geol. map, 1971.

Synorogenic clastic rocks of Mississippian age deposited in an elongate rapidly subsiding trough east of Antler orogenic belt in east-central Nevada consist of 7,000 feet of Chainman and Diamond Peak Formations which unconformably overlie Devonian and Mississippian Pilot Shale and Mississippian Joana Limestone, and are overlain by Mississippian-Pennsylvanian Ely Limestone. Younger rocks are the Permian Carbon Ridge Formation, Cretaceous Newark Canyon Formation, and Cretaceous and/or Tertiary fanglomerates and megabreccias. Contrasting facies of the Chainman Formation occur above and below a thrust fault of possible regional extent which also complicates stratigraphic relations of Diamond Peak Formation in the type locality at Diamond Peak. Eight members are recognized in this type section. Depositional environments of these members, provenance of the Chainman and Diamond Peak Formations, and tectonic structures of the area are discussed. — VSN

07669 **Brideaux, Wayne W.; Radforth, Norman W.** Upper Devonian miospores from the Escuminac Formation, eastern Quebec, Canada: Canadian Jour. Earth Sci., v. 7, no. 1, p. 29-45, illus., tables, 1970.

Miospores of early Frasnian age are described from the third unit of the Escuminac Formation in eastern Quebec, Canada. The assemblage comprises 34 species, including 8 species proposed as new, 2 new combinations, and 12 sparsely represented forms not considered synonymous with previously described species. The assemblage is most closely comparable to a Middle Devonian assemblage from the Orcadian Basin, Scotland; similarities are also noted with European and Russian assemblages. Except for five long-ranging species, elements of Lower Carboniferous assemblages are lacking. Evidence suggests a transitional nature for this Escuminac assemblage. Miospores of relatively large size, a feature of Middle Devonian assemblages, are present; marked differentiation of large and small spore types, found in several other Upper Devonian assemblages is absent. Apiculate and anchor-spined species dominate the Escuminac assemblage. — *from* Authors' abstract

07847 **Brindley, G. W.; Pedro, G.** Rapport du Comité International de Nomenclature AIPEA, Tokyo, 1969 [Report of the International Committee on Nomenclature, AIPEA, Tokyo, 1969]: Groupe Français Argiles Bull., v. 22, no. 1, p. 1-3, 1970.

The following points were taken up by the International Committee on Classification and Nomenclature of Clay Minerals at the 1969 meeting. (1) Definition of the "phyllosilicates" and the problem of relations between palygorskites-sepiolites and the group of phyllosilicates. (2) Imogolite, approved. (3) Sudoite-donbassite, three subgroups in the chlorite group were recommended based on structure. (4) Smectites and vermiculites, distinction. — ESL

07906 **Brindley, G. W.; Thompson, T. D.** Methylene blue absorption by montmorillonites; determination of surface areas and exchange capacities with different initial cation saturations (clay-organic studies XIX): Israel Jour. Chemistry, v. 8, no. 3, p. 409-415, illus., table, 1970.

When methylene blue is added to Li- and Na-montmorillonites dispersed in water, flocculation occurs when the amount absorbed effectively covers the surface of the clays. Two samples of K-montmorillonite did not disperse fully. With divalent ion saturations, the Wyoming and Texas clays behave differently with respect to methylene blue absorption, probably because the former has larger particles and

flocculation occurs when external areas are covered and internal only partially covered. Absorption beyond flocculation is very gradual, possibly because of steric problems in exchanging divalent cations for methylene blue cations. In the Texas clay, with smaller particle size, most of the internal surface as well as the external is covered. Absorption beyond flocculation proceeds rapidly to saturation. Fe(III)-montmorillonites behave anomalously, but no reasons have been found. — *from* Authors' conclusions

07819 **Bristol, C. C.** Geology of the Leftbrook Lake area (east half), The Pas mining district, Manitoba: Manitoba Dept. Mines and Nat. Resources Mines Br. Pub. 64-3, 19 p., illus., tables, geol. map, 1970.

In this area northwest of Thompson, rocks are charnockites, pyroxene granulites, and some metagabbro (all with plagioclase feldspar) of Precambrian, all closely related to the Nelson River gneiss belt in mineralogy, metamorphic grade and probably origin. Various mineral assemblages indicate original rock composition; Rosiwal analyses are shown in tables. Comparison of mineral distribution patterns with the geologic map does not indicate systematic variation in bulk chemistry among map units. Contacts are rarely exposed, but outcrop patterns correlate well with aeromagnetic data. While charnockites are found throughout the south, central and northern parts, concentration of modal quartz is restricted to the northwest corner. With primary structures eradicated by regional metamorphism and deformation, foliation and rock-type distribution patterns are dissimilar; the latter, some arcuate, may indicate previous structural trends. — GDC

07697 **Broecker, W. S.** Panel discussion [on isostasy], *in* Symposium on recent crustal movements, Ottawa, Canada, 1969, Papers: Canadian Jour. Earth Sci., v. 7, no. 2, pt. 2, p. 730, 1970.

Interior areas of the ice-covered terrane show an initial, very rapid rate of rebound, followed by a slower, exponential recovery, whereas the outer, or peripheral areas do not show the differential recovery. In those areas covered longer by the ice, the initial recovery may not be due to rebound but rather to some elastic or phase change phenomena. The varying elevations of the highest strand line must be due to something other than isostatic rebound and must reflect climatically induced deformations. Water-loading of the continental shelf and glacially excluded mantle material must be given serious attention. — HRC

Brookins, D. G. *See* Laughlin, A. W. 00490

08016 **Brown, Donald L.** Geologic map of the Buena Vista quadrangle, Tennessee: Tennessee Div. Geology Geol. Map GM 10-NE, scale 1:24,000, separate text, 1970.

07979 **Brown, I. C.** Groundwater geology, Chap. 13 *in* Geology and economic minerals of Canada: Canada Geol. Survey Econ. Geology Rept. 1 (5th edition), p. 765-791, illus., table, 1970.

In Canada ground water contributes about ten percent of water for municipal water supply systems in communities of more than 1,000 inhabitants and an equal or greater proportion of that used for individual homes. Quantities of ground water are also used for industry and irrigation. Long-term ground-water fluctuations in most areas of Canada vary from 5 to 20 feet, whereas those caused by man's interference can be several inches to many tens of feet. Recharge is greatest and ground-water levels highest during spring break-up. Lowest levels are reached in early fall, but autumn rains provide considerable recharge. Six hydrogeological regions and their subdivisions are discussed: Appalachians, St. Lawrence Lowlands, Canadian Shield, Interior Plains, Cordilleran, and Northern. — EH

08003 **Brown, L. F., Jr.; Fisher, W. L.** An approach to environmental geology with examples from the Texas coastal zone, *in* Environmental geology — AGI short course lecture notes, Milwaukee, Wis., 1970: Washington, D. C., Am. Geol. Inst., 39 p., paged separately, illus., tables, 1970.

The most urgent need in environmental geology is the mapping and delineation of genetic bedrock units and of modern facies and their interrelated causative processes. Basic geologic maps are needed as a base for environmental geology maps which show the distribution of these processes and facies, as well as a 3-dimensional picture of ancient facies and inferred processes. This information is coordinated with that of other disciplines and is translated into data and maps understandable to planners, legislators, and other non-geologists. The author gives an example of environmental geologic mapping currently underway in Texas. Geologic map units and derived, interpreted, and compiled map units for an environmental geologic atlas of the Texas coastal zone are included, as well as a description of the format. — EH

08055 **Brown, R. L.; Helmstaedt, H.** Deformation history in part of the Lubec-Belleisle zone of southern New Brunswick: Canadian Jour. Earth Sci., v. 7, no. 3, p. 748-767, illus., tables, 1970.

The Proterozoic Coldbrook Groups on the north shore of the Bay of Fundy lie south of the northeast-trending Lubec-Belleisle fault. North of the fault is the Paleozoic Mascarene Group overlain by Devonian and Carboniferous rocks. The Coldbrook and Mascarene Groups have been deformed in three phases; the action was coeval, and penetrative fabrics first developed during the Acadian orogeny. Mylonitic fabrics formed in Coldbrook rocks during the first two phases of the Acadian. No evidence for major northeast-southwest strike-slip faulting is evident. The bulk of the ductile strain (first two phases) occurred in response to northwest principal compressive stress during the Middle Devonian, and these stresses were reestablished in post-Devonian times, resulting in the development of high angle oblique to dip-slip movements on the northeast-trending faults. — *from* Authors' abstract

Bryan, George M. *See* Stoll, Robert D. 00547

Bryant, William R. *See* Pequegnat, Willis E. 00437

08045 **Bryson, Reid A.; Baerreis, David A.; Wendland, Wayne M.** The character of late-glacial and post-glacial climatic changes, *in* Pleistocene and recent environments of the central Great Plains: Kansas Univ. Dept. Geology Spec. Pub. 3, p. 53-74, illus., tables, 1970.

Computer analysis of world-wide radiocarbon dates for significant climatically related events of the last 10,000 years yields an objective consensus that these events occurred at preferred times. These dates match recent datings of the breaks in the Blytt-Sernander sequence, and are also applicable to North America. Major climatic changes are global and synchronous and occur with considerable rapidity. Periods between changes constitute quasi-stable episodes broken into subepisodes by minor changes. It is concluded that a series of quasi-stable climatic episodes separated by rapid transitions is a better working hypothesis than that of a steady postglacial rise of temperatures to an optimum followed by a steady decline. — VSN

00383 **Buie, B. F.** Evaluation of kaolin deposits [abs]: Econ. Geology, v. 66, no. 1, p. 206, 1971.

07741 **Bullock, Kenneth C.** Iron deposits of Utah: Utah Geol. and Mineralog. Survey Bull. 88, 101 p., illus., tables, geol. map, 1970.

The Iron Springs district on the eastern edge of the Basin and Range province in southwestern Utah is the largest iron-producing district in the western United States. Ore bodies lie 12 to 20 miles west of Cedar City. Deposits are clustered along the complexly folded and faulted margins of three intrusions of quartz monzonite porphyry which are flanked by Jurassic, Cretaceous, and Tertiary sedimentary strata and Tertiary volcanics. Principal iron ore minerals are hematite and magnetite. The ore occurs as contact metasomatic-hydrothermal replacements and breccia fillings mainly in Jurassic limestone, but also in younger strata and porphyry. Small fissure veins of magnetite occur in all three porphyry intrusions. From several open-pit mines 78 million long tons of iron ore were produced from 1923 through 1968 and there is a probable ore potential of more than 300 million long tons. — *from* Author's abstract

07957 **Bunting, B. T.; Jackson, R. H.** Studies of patterned ground on SW Devon Island, N.W.T. — A method for collecting undisturbed megasamples from dry Arctic polygons, and observations on some physical properties of the material in a sorted polygon: Geog. Annaler, Ser. A, Phys. Geog., v. 52A, no. 3-4, p. 194-208, illus., tables, 1970.

A method is outlined for hardening and sampling a large circular mass of polygonal ground using acrylic polyester resin. The sample may be preserved for display or subsampled on a controlled basis. This method facilitates measurement of granulometry, orientation, and physical characteristics, while permafrost layers are more accessible. Analyses of material from the stone rim and clay plug of the polygon are presented in a second paper [ibid., p. 209-212]. The hypothesis is advanced that some polygonal features must result from interaction of two layers of differing texture rather than through differential sorting of stones and fines from a heterogeneous parent material. Gravel in margins of polygons is coarse and angular at the surface, more rounded at depth. Gravel in clay plugs is coarse and well rounded at depth. Material in clay plugs has higher liquid limit and lower bulk density, and has an accumulation of organic matter in the center. — *from* Authors' abstract

07959 **Bunting, B. T.; Hathout, S. A.** Observations on the organic matter associated with the surface organic layers of arctic polygons: Geog. Annaler, Ser. A, Phys. Geog., v. 52A, no. 3-4, p. 209-212, tables, 1970.

Analyses of organic matter and organic acid typification of samples gathered from the surfaces of sorted and of stable soils on SW Devon Island show that the organic materials on the surface of arctic polygons are dominantly of a hemic nature with relatively low bulk density and moderate fibre volume, low nitrate nitrogen, low exchangeable chloride and ash contents, and are dominated by humic acids. Saturation moisture percentages and pH values are high when compared to mean and median values from a variety of other more stable sites. Organic matter from such stable sites shows generally greater amounts of fulvic acids and physical properties more akin to sapric soil materials on wet but stable sites; while dry sites have higher ash contents and higher bulk density than the organic matter on unstable polygon margins. — Authors' abstract

07917 **Burgess, Lawrence Charles Norman.** The application of airphoto interpretation to watershed planning and development with special reference to flood susceptibility and frequency determinations [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 31, no. 6, p. 3471B, 1970.

07827 **Burnham, J. B.; Stewart, D. H.** The economics of Plowshare geothermal power, *in* Symposium on engineering with nuclear explosives — Am. Nuclear Soc. and U.S. Atomic Energy Comm., Las Vegas, Nev., 1970, Proc., V. 2: Springfield, Va., Clearinghouse Federal Sci. and Tech. Inf., p. 1376-1383, illus., 1970.

A preliminary analysis is made of the concept of using the rock crushing power of a nuclear device in a geothermal area (not steam area) to produce a large cavity filled with broken rock from which the sensible heat can by removed by drilling a hole into the cavity bottom and adding water; steam is removed at the top. The ideal site should have rock temperatures above 600° F at depths of 6,000 to 10,000 feet, large quantities of surface water for cooling the steam condenser, and an area remote from large population centers but near major electrical transmission lines. Such sites can be found in Oregon, Nevada, Idaho, Montana, Utah, and California. An alternative arrangement to the single drilled hole involves a pressurized water system for heat removal using a sequential-horizontal shot array with water pumped in at the top and withdrawn at the bottom. Costs of such systems are examined and shown to be extremely reasonable in relation to oil recovery. — VSN

07892 **Bush, Gordon L.; Dooge, Jasper.** (editors). Peace River, Pine Pass, Yellowhead 1970 — Edmonton Geol. Soc. Field Conf., 12th, Guidebook: Edmonton, Alberta, Edmonton Geological Society, 143 p., illus., tables, geol. maps, 1970.

Eight papers dealing with stratigraphy and structural geology of this area in British Columbia and Alberta are included with five road logs, and are cited separately. Two

sheets of a geologic map of Pine River Valley, originally published with British Columbia Dept. Mines and Petroleum Resources Bull. 52 (1966), accompany the text. — ESL

07725 **Bushnell, Vivian C.; Ragle, Richard H.** (editors). Icefield Ranges Research Project, scientific results, V. 2: New York, Am. Geog. Soc., *and* Montreal, Quebec, Arctic Inst. No. America, 138 p., illus., tables, 1970.

The 15 papers in this volume report research carried out during 1965-1968. While Volume 1 was concerned entirely with the physical sciences, Volume 2 includes five papers in the biological sciences. Three of the physical science papers are cited separately. — ESL

00557 **Butkovich, T. R.** Influence of water in rocks on effects of underground nuclear explosions: Jour. Geophys. Research, v. 76, no. 8, p. 1993-2011, illus., tables, 1971.

The influence of water in silicate rocks in which underground nuclear explosions were detonated has been observed. In high-water-content rock larger cavities are formed, and in cratering shots higher peak spall velocities occur in the case of high-water-content rock. A water-boost model is proposed whereby the region around an underground nuclear explosion is treated as a two-component system on release from its peak shock pressure. The model was tested by making one-dimensional calculations with a computer code designed to calculate the effects of underground explosions on the environment. The results were compared with measurements in rocks with water contents up to more than 25 percent by weight. Excellent agreement was obtained for peak stress in the kilobar region, cavity radius, and free surface velocity for a cratering event. — *from* Author's abstract

00414 **Butler, J. Robert; Daniel, Charles C., 3d.** Chemistry and mineralogy of metasedimentary rocks in the Albemarle area, North Carolina slate belt: Southeastern Geology, v. 12, no. 3, p. 159-168, illus., tables, 1971.

Metasedimentary rocks in the Albemarle area are mainly argillites, tuffaceous argillites, and graywackes, interlayered with and gradational into metavolcanic rocks described in an earlier report (Butler and Ragland, 1969). Samples from eight localities, including type localities of the Tillery Formation, McManus Formation, and Yadkin Graywacke were selected for bulk chemical and X-ray modal analysis. The rocks are composed mainly of quartz, albite, muscovite, and chlorite, with smaller sporadic amounts of biotite, actinolite, epidote, calcite, microcline, and opaque minerals. Mineral assemblages are indicative of lower greenschist facies (biotite or chlorite zone) of regional metamorphism. The rocks have been affected by metasomatism, but retain bulk chemical compositions generally similar to argillite and graywacke from other regions. — *from* Authors' abstract

Cailleux, Andre. *See* Rochette, Jean-Claude. 00474

07863 **California Dept. Water Resources.** Hydrologic data, 1968 — V. 2, Northeastern California — App. C, Ground water measurements; App. D, Surface water quality; App. E, Ground water quality: California Dept. Water Resources Bull. 130-68, V. 2, p. 325-566, illus., tables, 1970.

The report contains tables showing data on climate, surface-water flow, ground-water levels, and surface- and ground-water quality in northeastern California for the 1967-68 water year. Figures show the location of climatological observation stations and ground-water basins; the average depth to water in wells; fluctuation of water level in wells; the location of surface-water measurement and surface-water quality stations; the maximum, minimum, and average daily specific conductance at selected stations; daily water temperatures; lines of maximum annual salinity encroachment; and major drainage and hydrographic unit boundaries. — Authors' abstract

07864 **California Dept. Water Resources.** Hydrologic data, 1969 — V. 4, San Joaquin Valley — App. C, Ground water measurements; App. D, Surface water quality; App. E, Ground water quality: California Dept. Water Resources Bull. 130-69, V. 4, p. 149-249, illus., tables, 1970.

The report contains tables showing data on climate, surface water flow, ground-water levels, and surface- and ground-water quality in the San Joaquin Valley for the 1968-69 water year. Figures show location of climatological, surface water, and surface-water quality measurement stations; fluctuation of water levels in selected wells and areas; and electrical conductance at selected stations. Plates show lines of equal elevation of water in wells, spring 1969; profile of ground-water levels; cooperative study areas; ground-water level changes; and well locations. — Authors' abstract

07834 **Cameron, I. G.; Scorgie, G. C.** Theoretical model of the early phases of an underground explosion, *in* Symposium on engineering with nuclear explosives — Am. Nuclear Soc. and U.S. Atomic Energy Comm., Las Vegas, Nev., 1970, Proc., V. 1: Springfield, Va., Clearinghouse Federal Sci. and Tech. Inf., p. 221-229, illus., 1970.

In early phases of intense underground explosions the rock near the explosive exhibits fluid behavior; at great distances its behavior can be investigated in terms of linear elasticity; and at intermediate distance as a solid exhibiting inelastic effects including cracking and tensile fracture. This paper outlines a mathematical model which includes these main features in this range of behavior. It is concluded that by adopting a flow or incremental model of solid behavior it is possible to extend the computational techniques of fluid dynamics to include many aspects of solid behavior, both elastic and inelastic. Two exploratory numerical examples are cited. — VSN

Campbell, J. Frisbee. *See* Furumoto, Augustine S. 00471

07899 **Campbell, R. B.; Charlesworth, H. A. K.** Geology of the region between Prince George and Jasper, *in* Peace River, Pine Pass, Yellowhead, 1970 — Edmonton Geol. Soc. Field Conf., 12th, Guidebook: Edmonton, Alberta, Edmonton Geological Society, p. 84-93, illus., table, 1970.

The route follows the Fraser River along the Rocky Mtn. Trench between the Cariboo and Rocky Mts. and into the Rocky Mts., divided here into the Main Ranges with Precambrian and lower Paleozoic rocks, and the Front Ranges with Paleozoic and Mesozoic. The field trip ends at the boundary between these two. A fold-in geologic map is included. Geologic features visited include the Quesnel Trough, tectonic rather than sedimentary, and the Omenica geanticline. The petrology and possible correlations of the Kaza, Cariboo, and Slide Mtn. Groups are given. Structural and stratigraphic differences between the Cariboo Mts. and the Main Ranges of the Rockies are gradational rather than exactly on the line of the trench. A colmination affecting the Main Ranges is associated with a sigmoidal configuration to the structural grain. The Miette Group has experienced more deformation than other stratigraphic levels. — ESL

07798 **Canada Geological Survey.** Index of publications, Geological Survey of Canada (1959-1969) [with French introduction]: Ottawa, Canada, Canada Geol. Survey, 123 p., 1970.

This ten-year index is a continuation of the index prepared by A. G. Johnson covering the period from 1945-1958. Together they include all Geological Survey Publications issued up to December 1969. In addition to the catalog of publications, there is a finding list based on the National Topographic System, an index map showing the NTS units, and an alphabetical author index. — GDC

Canis, Wayne F. *See* Gutschick, Raymond C. 00516

07776 **Canney, F. C.** Remote detection of geochemical soil anomalies, *in* Earth Resources Aircraft Program, status review, V. 1: Houston, Tex., U.S. Natl. Aeronautics and Space Admin., Manned Spacecraft Center, p. 7-1—7-8, illus., tables, [1970,].

A preliminary experiment is described that was made to compare spectral reflectance from trees in soil over a mineral deposit with reflectance from trees of the same species (balsam fir, red spruce) in a nearby unmineralized area. Results suggest that measurement of spectral reflectance may become a dramatic new way of detecting geochemical soil anomalies by remote sensing in tree-covered areas. The test site

was Catheart Mountain in west-central Maine where there is a large, low-grade copper-molybdenum deposit. — VSN

Cannon, P. J. *See* Rowan, L. C. 07774

07740 **Carlquist, Sherwin John.** Hawaii — A natural history: Garden City, New York, The Natural History Press, 463 p., illus., 1970.

The geology, climate, flora and fauna of the Hawaiian Islands are described and profusely illustrated. Volcanic processes and the volcanic history of the islands are discussed, using the island of Oahu as a case study, as well as volcanic features, products and rocks. The effects of erosion, weathering and coral growth and the ground-water situation on the islands are briefly covered. A general description is given of each island of the lesser chain of the Hawaiian Islands. — EH

Carlson, Robert F. *See* Hartman, Charles W. 07877

07703 **Carmichael, C. M.** The Mid-Atlantic Ridge near 45° N. — [Pt.] 7, Magnetic properties and opaque mineralogy of dredged samples: Canadian Jour. Earth Sci., v. 7, no. 2, pt. 1, p. 239-256, illus., tables, 1970.

Measurements of magnetic properties, paleomagnetic field intensity, and inferred paleomagnetic field polarity have been made using fine grained basalt and coarser grained rock samples dredged from the Mid-Atlantic Ridge near 45° N., supplied by the Geological Survey of Canada. Opaque mineralogy of samples was studied by microscope, Curie point, and X-ray diffraction techniques. Natural remanent magnetization of the basalt is of the order of 5 to 10×10^{-3} e.m.u./cm^3 with some values from the center of the median valley reaching 10^{-1} e.m.u./cm^3. Magnetic anomalies over the ridge can be accounted for by remanent magnetization of a few hundred meters of this basalt. Coarse grained rocks were relatively weakly magnetized, and while they contribute little to the magnetic anomalies, their diverse character suggests the major portion of the oceanic crust, below a thin veneer of fine grained basalt, has differentiated into a complex structure. — *from* Author's abstract

Cassity, Paul E. *See* Weir, Gordon W. 00459

07804 **Castillo Tejero, C.** La percepción remota como auxiliar en la exploración de recursos naturales [Remote sensing as an aid in exploration for natural resources (with Spanish abs.)]: Rev. Inst. Mexicano Petróleo Rev., v. 2, no. 4, p. 5-19, illus., 1970.

Techniques of remote sensing have demonstrated their usefulness in exploration for natural resources. A description is given of instruments used in airplanes, ships or satellites which can pick up natural or induced radiation of substances in different bands of the electromagnetic spectrum. The information comes from the ordinary photographs or from infrared or radar imagery which these instruments provide. The importance of geologic concepts in interpreting data provided by sensors is noted. The remote-sensing program was introduced in Mexico in 1965 by the National Commission of Outer Space with participation of various Mexican institutions, among them the Mexican Institute of Petroleum. — *from* Author's abstract, EH

Castillo-Tejero, Carlos. *See* Viniegra O., Francisco. 07848

Causey, J. D. *See* Laughlin, A. W. 00490

Chamberlain, J. A. *See* Land, A. H. 07972

00421 **Chamberlin, C. Kent.** Morphology and ethology of trace fossils from the Ouachita Mountains, southeast Oklahoma: Jour. Paleontology, v. 45, no. 2, p. 212-246, illus., tables, 1971.

Trace fossils from the Mississippian and Pennsylvanian rocks of Ouachita Mountains, presumably representing marine invertibrates, are illustrated and described, including 6 new ichnogenera and 11 new ichnospecies. A total of 44 ichnospecies are

referred to 32 ichnogenera and assigned to Seilacher's (1953-1954) behavioral types. Many of the old and new forms are the only representations of soft-bodied animals otherwise unknown. Shallow and deep water forms occur only a few miles apart in synchronous rocks, making possible the observation of lateral and vertical distribution of particular behavioral types. — JWH

07881 **Chandra, Umesh.** Table for the angles of incidence at the focus for S waves based on Randall's revised S tables: Earthquake Notes, v. 41, no. 4, p. 35-43, table, 1970.

A table for the angles of incidence of S-waves at the focus, as a function of focal depth and epicentral distance is presented. The calculations are based on the revised S-traveltime table by Randall (1970). — Author's abstract

07793 **Chapman, Peter; Quade, Jack; Brennan, Peter; Blinn, John C., 3d.** Ground truth/sensor correlation, *in* Earth Resources Aircraft Program, status review, 2d Ann., Houston, Tex., 1969 — V. 2, Agriculture, Forestry, and sensor studies: Houston, Tex., U.S. Natl. Aeronautics and Space Admin., Manned Spacecraft Center, p. 31-1—31-28, illus., tables, [1970,].

Remote sensing of simple geologic features was investigated in 1968 by flights across the Mount Lassen, Calif., test site using a four-channel microwave radiometer supported by radar scatterometers, thermal infrared imagers, and color infrared photography. Intensive ground measurements of thermal and physical characteristics of materials at the test site were also conducted as an aid in future interpretations. The multifrequency microwave data indicate an ability to differentiate materials on the basis of density, thermal characteristics, and surface roughness, and the 13.3 GHz scatterometer on the basis of particle size with sensitivity for surface geometry when particulate material is small in relation to Rayleigh scattering coefficient. — VSN

07713 **Chapple, William M.** The finite-amplitude instability in the folding of layered rocks: Canadian Jour. Earth Sci., v. 7, no. 2, pt. 1, p. 457-466, illus., 1970.

If fold-causing stresses are constant, the overall shortening strain-rate will first show a marked increase with increasing fold amplitude and then decrease as the fold becomes tightly appressed; if the shortening strain-rate is constant, the stresses needed to maintain this will decrease and then increase again. This instability results in a bulk-effective viscosity with respect to layer-parallel compression which is at first high, then decreases to a minimum and then rises again. Consideration of decollement folding and multilayer folding suggests that the concept of finite-amplitude instability may be applicable, at least qualitatively, to these more common fold types. If this is true, then the concept is important in considering more general geologic questions such as the dating of an orogenic episode by angular unconformity. — *from* Author's abstract

Charlesworth, H. A. K. *See* Campbell, R. B. 07899

Cheney, Eric S. *See* Lange, Ian M. 00373

07908 **Cherry, J. T.; Petersen, F. L.** Numerical simulation of stress wave propagation from underground nuclear explosions, *in* Symposium on engineering with nuclear explosives — Am. Nuclear Soc. and U.S. Atomic Energy Comm., Las Vegas, Nev., 1970, Proc., V. 1: Springfield, Va., Clearinghouse Federal Sci. and Tech. Inf., p. 142-220, illus., 1970.

A numerical model of stress wave propagation (SOC) is presented which uses material properties data from a preshot testing program to predict stress-induced effects on the rock mass involved in a Plowshare application. SOC calculates stress and particle velocity history, cavity radius, extent of brittle failure, and the rock's efficiency for transmitting stress. Calculations are based on an equation of state for the rock, developed from preshot field and laboratory measurements of rock properties. Rock properties were determined in situ from well logs and in the laboratory on rock cores. Equation-of-state data are presented for rock from three sites subjected to high explosive or underground nuclear shots and calculated shot effects are compared with observed effects on surrounding rocks. — VSN

Cherry, R. N. *See* Hunn, J. D. 08075

00576 **Chesworth, Ward.** Mineral synthesis in the system Al_2O_3-H_2O — An amalgamation technique: Nature Phys. Sci., v. 230, no. 10, p. 65, table, 1971.

A comparatively rapid method of synthesizing phases in the system Al_2O_3-H_2O under conditions at the Earth's surface has been available since at least 1870. Aluminum dissolved in mercury displaces hydrogen from water to form bayerite. The method can be modified to yield other hydroxides and oxyhydroxides by using reacting media other than water. It is premature to interpret natural occurrences in terms of such syntheses, but the significant point is that both hydroxide and oxyhydroxide phases can be formed under the temperature and pressure conditions prevailing at the Earth's surface. Thus the presence of an oxyhydroxide phase need not indicate a high temperature or a disequilibrium episode; it might indicate conditions such as in soils formed in arid or semi-arid regions or in areas where the soil-water contained high concentrations of dissolved impurities. — DBV

Choquette, Philip W. *See* Stromquist, Arvid A. 00465

08062 **Church, W. R.; Young, G. M.** Discussion of the progress report of the Federal-Provincial Committee on Huronian Stratigraphy: Canadian Jour. Earth Sci., v. 7, no. 3, p. 912-918, table, 1970.

It is argued that the term "Huronian", which has been, and still is, widely used as a time-stratigraphic term, serves a useful purpose in correlating the early Proterozoic rocks of Ontario with those of the Lake Superior region. It should not be used, therefore, as a rock-stratigraphic name of only local significance, as has been suggested in the progress report of the Federal-Provincial Committee on Huronian Stratigraphy, but be retained as an informal 'systemic' name pending clarification of conflicting results of age relationships of early Proterozoic rocks of the Great Lakes region. A scheme of stratigraphic nomenclature is tentatively outlined for the early Proterozoic rocks of the Great Lakes region. — Authors' abstract

08072 **Churcher, C. S.; Stalker, A. MacS.** A late, postglacial horse from Pashley, Alberta: Canadian Jour. Earth Sci., v. 7, no. 3, p. 1020-1026, illus., tables, 1970.

Elements from the left hind foot of a small horse, probably *Equus conversidens* Owen, are reported from a few miles southeast of Medicine Hat, Alberta. The bones were found below a buried soil contained within an eastward-striking glacial spillway. A date of about 8000 y B.P. is suggested for the specimens on stratigraphic considerations. If this date is correct, these bones probably represent the youngest indigenous fossil horse known in North America. — Authors' abstract

Clark, L. A. *See* Shewman, R. W. 07671

07777 **Clark, Malcolm M.** Geologic utility of small-scale airphotos, *in* Earth Resources Aircraft Program, status review, V. 1: Houston, Tex., U.S. Natl. Aeronautics and Space Admin., Manned Spacecraft Center, p. 8-1—8-31, illus., [1970,].

The geologic value of small-scale airphotos is emphasized by describing the application of high-altitude oblique and 1:120,000 to 1:145,000 scale vertical airphotos to several geologic problems [mostly faults] in California. Examples show that such airphotos are of use to geologists in the following ways: High-altitude, high-oblique airphotos show vast areas in one view and introduce salient geographic and topographic attributes and many geologic features of an area. Vertical airphotos are the most efficient method of discovering major topographic features and important structural and lithologic characteristics of new or unfamiliar terrain; in stereo they show broad regions in one three-dimensional view and may reveal features of such extent that a broad view is necessary to recognize them. — *from* Author's abstract

08078 **Clark, R. H.; Personge, N. P.** Some implications of crustal movement in engineering planning, *in* Symposium on recent crustal movements, Ottawa, Canada, 1969, Papers: Canadian Jour. Earth Sci., v. 7, no. 2, pt. 2, p. 628-633, illus., table, 1970.

In the Great Lakes basin, there is evidence of uplift of the crust of about 1 ft per 100 yr in the northeast relative to the southwest, resulting in water level lowering to the northeast and a rise to the southwest. In Lakes Ontario and Huron, average depth will change with time. In Lake Huron it will gradually decrease because the bed underlying the lake is rising with respect to the lake outlet. In Lake Ontario the depth of the water will increase since the outlet is rising with respect to the remainder of the lake. This paper reviews some of the engineering implications of the relative rates of crustal movement in the Great Lakes region on long-term management of water levels of the Great Lakes. — *from* Authors' abstract

00441 **Clark, T. H.** Elkanah Billings (1820-1876) — Canada's first paleontologist, *in* History of Canadian Geologists: Geol. Assoc. Canada Proc., v. 23, p. 11-14, portrait, 1971.

07918 **Clay, Donald Wayne.** Stratigraphy and petrology of the Mineta Formation in Pima and eastern Cochise Counties, Arizona [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 31, no. 6, p. 3478B-3479B, 1970.

Coakley, John P. *See* Rust, Brian R. 08061

Coats, R. R. *See* Roberts, Ralph J. 00369

Cobb, Glen E. *See* Gumert, William R. 07993

07871 **Cocke, J. M.** Dissepimental rugose corals of Upper Pennsylvanian (Missourian) rocks of Kansas: Kansas Univ. Paleont. Contr. Art. 54 (Coelenterata 4), 67 p., illus., tables, 1970.

The Upper Pennsylvanian consists of alternating limestone and shale. Each limestone formation is divided into a normal facies belt of thin limestones, and at least one phylloid algal mound complex belt. Twenty-six species of dissepimental corals, 12 new, are described from both facies belts, but not from the thick shales. Four faunal zones are recognized, three in the Kansas City Group, and one in the Lansing; possible correlations are discussed. *Dibunophyllum parvum*, which appears first in the Wyandotte Fm., shows the only documented evolutionary sequence. Culmination of trends of changes within the lineage probably led to development of a described new species in uppermost Missourian, and to other species in Virgilian and Permian units in Texas. — *from* Author's abstract

Cohen, Lewis H. *See* Jayaraman, A. 07749

07982 **Colbert, Edwin Harris.** The Triassic gliding reptile *Icarosaurus*: Am. Mus. Nat. History Bull., v. 143, art. 2, p. 85-142, illus., tables, 1970.

This study supplements the original diagnosis and preliminary description of *Icarosaurus siefkeri* (Colbert, 1966) from the Lockatong Formation of the Upper Triassic Newark Group at North Bergen, N.J. A detailed description is here presented against the background of P. L. Robinson's (in prep.) monograph on *Kuehneosaurus*, a closely related genus from the Keuper of England; the special adaptations for gliding and the aerodynamic problems that bear on them are analyzed, in comparison with the modern gliding lizard *Draco*. Revised diagnoses are presented for the genus and for the family Kuehneosauridae, including both genera, in the infraorder Eolacertilia. Transition from prolacertilian eosuchian to lacertilian may have taken place during the Middle Triassic; by Late Triassic, the kuehneosaurids, by far the earliest known lacertilians, had already become highly modified from a central lacertilian stock. — VMJ

00497 **Cole, W. Storrs.** Internal structure of three American species of *Rotaliina* (Foraminifera): Jour. Foraminiferal Research, v. 1, no. 1, p. 29-38, illus., 1971.

Internal structures are described and illustrated for three foraminiferal species of Rotaliina, the nomenclatural history of each is briefly reviewed, and the stratigraphic position is analyzed. *Eponides gunteri* Cole, 1942, middle Eocene, Florida (synonym,

Lockhartia cushmani 0Applin and Jordan, 1945) is transferred to *Rotalia*. *E. jamaicensis* Cushman and Jarvis, 1931, Jamaica, Cuba, Puerto Rico (synonym, *Lockhartia bermudezi* Cole, 1942) is retained in *Kathina* (Smout, 1954), not *Smoutina* of later authors; its age, originally considered middle Eocene, is established as Upper Cretaceous. *Amphistegina cubensis* D. K. Palmer, 1934, upper Eocene, Cuba, is a microspheric form; *A. pinarensis* Cushman and Bermudez, 1937, middle and upper Eocene, Cuba and Florida, the megalospheric form, becomes a junior synonym. — VMJ

07748 **Coleman, L. C.** Rb/Sr isochrons for some Precambrian rocks in the Hanson Lake area, Saskatchewan: Canadian Jour. Earth Sci., v. 7, no. 2, pt. 1, p. 338-345, illus., tables, 1970.

Rb-Sr whole rock analyses of rocks from the Hanson Lake area, Saskatchewan, combined with geological evidence suggest that there were three thermal events in that region during Precambrian time. During Archean time, a period of volcanism about 2520 m.y. ago was followed by a period of granite intrusion about 2445 m.y. ago. During Aphebian time, the rocks of the area were intruded by pegmatites about 1800 m.y. ago. If the analytical data alone are considered, the two earlier events should be considered as one that took place about 2425 m.y. ago. — Author's abstract

07729 **Coll de Hurtado, Atlántida.** Aspectos de morfológia litoral en México [Aspects of coastal morphology in Mexico]: México Univ. Nac. Autónoma Inst. Geografía Bol., v. 3, p. 197-199, illus., 1970.

Coastal geomorphologic processes, such as erosion, lithology, tectonic movement, and the origin of coastal materials are discussed. In Mexico, the Pacific coast, generally high and composed of crystalline and igneous rocks, is occasionally interrupted by beaches and lagoons and peters out into coastal plains toward the north. On the Gulf of Mexico the coast is generally low, with sandy beaches and dunes and some swampy areas. On the coasts of Yucatan small limestone cliffs alternate with long beaches, and coral reefs and atolls are often present on the north and east coasts. — EH

07730 **Coll de Hurtado, Atlántida.** Carta geomorfológica de la región costera de los Tuxtlas, Estado de Veracruz [Geomorphologic map of the coastal region of los Tuxtlas, State of Veracruz]: México Univ. Nac. Autónoma Inst. Geografía Bol., v. 3, p. 23-28, 1970.

The two-part geomorphologic map of the coastal region of los Tuxtlas was made from aerial photographs at the scale of 1:50,000. Cartographic symbols include accumulation and ablation forms, and lithologic, hydrographic, and topographic features. The volcanic massif of los Tuxtlas, formed principally of sand and ash of Oligocene to recent age, with volcanoes of basalt or pillow lava rising from it, determines the relief, hydrography, soils, vegetation and therefore the cultural features. — EH

07865 **Comm. on Subsoils of Boston; Borbereky, Horst; Battles, Richard F.; Haley, James F.; LeCount, Peter F.; Linehan, Daniel.** (compilers). Boring data from greater Boston — Sec. 2, Roxbury: Boston Soc. Civil Engineers Jour., v. 57, no. 3, p. 185-291, illus., table, 1970.

The tabulation presented here was prepared in the same manner as for Boston Peninsula (the first of this series; ibid., v. 56, nos. 3-4, 1969; *see* Abstracts of North American Geology, Dec. 1970); it covers Roxbury and includes 1,214 borings, with locations shown on an accompanying map. As before, the columns give depths from ground surface, and soil constituents, and indicate consistency of the material in penetration resistence. At the bottom of each log the elevation of existing ground and the depth to ground water are given. — GDC

00384 **Conn, Herbert K.; Mann, Ernest L.** Evaluation of asbestos deposits [abs]: Econ. Geology, v. 66, no. 1, p. 206, 1971.

07919 **Cook, Beverly Kay Gatlin.** Petrochemistry of the Buck Hill volcanic series, Cathedral Mountain quadrangle, Brewster County, Texas [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 31, no. 6, p. 3479B, 1970.

Copland, A. B. *See* Barss, D. L. 07755

08009 **Corbishley, Derek J.** Structure under seismic arrays: Royal Astron. Soc. Geophys. Jour., v. 21, no. 5, p. 415-425, illus., table, 1970.

Site corrections have been derived for each seismometer location at four seismic arrays. The corrections allow for the effects of local structure and contain both a constant and azimuthally varying term. They are valid for teleseismic P arrivals from epicentral distances between 30°-104°. The corrections at Eskadalemuir (Scotland) are related to the altitude of the sites. Those at Warramunga (Australia) show evidence of a layered structure dipping at 4° in the direction N. 195° E. and a complex region near the crossover point of the two array arms. The corrections at Yellowknife (Canada) and Gauribidanur (India) are small and imply that the subarray structure is essentially horizontal. — Author's summary

07963 **Costello, W. R.** River channel and tidal bar deposits Gaspé Nord, Quebec: Maritime Sediments, v. 6, no. 2, p. 68-71, illus., 1970.

A preliminary study of the rivers and streams draining into the St. Lawrence Estuary from the Gaspe Peninsula indicates that large amounts of glacial sediments and newly eroded Paleozoic rocks are being transported to the coast. Much of the sediment that is being supplied to the intertidal area is in the size range of medium sand to gravel. The nature and extent of these coarse sediment deposits can be seen in the extensive development of gravel bars in the mid-channels of the rivers draining into the estuary. — Author's abstract

08077 **Cox, Edward R.** Preliminary report on remote sensing in water-resources studies in Yellowstone National Park, Wyoming, *in* Earth Resources Aircraft Program, status review, 2d Ann., Houston, Tex., 1969 — V. 3, Hydrology and oceanography: Houston, Tex., U.S. Natl. Aeronautics and Space Admin., Manned Spacecraft Center, p. 45-1—45-9, illus., [1970,].

Remote-sensing data from Yellowstone National Park, particularly infrared imagery obtained from aircraft in 1966 and 1967, are being studied, and methods of interpretation are being developed to correlate remote-sensing and ground-truth data. Areas that show promise for correlation are near Old Faithful, Fountain Paint Pot, Shoshone Lake, Norris Junction, and West Thumb. Parches of snow correlated exactly with relatively cool areas interpreted from infrared imagery. A snow line across Nez Perce Creek valley near Fountain Paint Pot correlates with a boundary between cool and warm ground water determined from augered test holes. Additional remote-sensing data, particularly low-altitude infrared imagery and photography are needed in areas where hydrologic ground-truth data are available. — *from* Author's abstract

Cragg, C. B. *See* Thode, H. G. 00487

07696 **Crittenden, M. D., Jr.** Panel discussion [on isostasy], *in* Symposium on recent crustal movements, Ottawa, Canada, 1969, Papers: Canadian Jour. Earth Sci., v. 7, no. 2, pt. 2, p. 727-729, illus., 1970.

Lake Bonneville in Utah and the isostatic readjustment associated with it can be used as a good example of an independent measure of the relaxation time that characterizes the Earth's response to loads of small diameters. It provides an unusually explicit measure of the upper limit of finite strength for the material involved in such response (a few bars or perhaps zero) and this in turn implies that loads of long wavelength and of long duration will attain isostatic balance with a high degree of precision. Also, the simultaneous interaction of isostatic recovery and Basin-and-Range faulting in the Bonneville area indicates that the two processes operate independently and probably in physically separated parts of the crust and mantle. — HRC

Crompton, C. W. *See* Bassett, I. J. 00484

08050 **Cross, Frank B.** Fishes as indicators of Pleistocene and recent environments in the Central Plains, *in* Pleistocene and recent environments of the central Great Plains: Kansas Univ. Dept. Geology Spec. Pub. 3, p. 241-257, illus., 1970.

All Pleistocene fishes determined from plains sites seem identical with modern species, implying conservative evolutionary rates and lengthy opportunity for dispersal. Changes in drainage patterns since the Pliocene may explain the wide dispersal of many species and the preponderant influence of local habitat conditions on present composition of local faunas. Thus, fishes are useful indicators of post-Pliocene environmental change. Supplementing fossil evidence, the presently discontinuous ranges of several species and records of recent distributional change in other species provide evidence of change in plains environments from Pleistocene to present and imply reduction in amount of surface water and diversity of aquatic habitats in Central and Southwestern Plains. Man's alteration of the environment has modified distribution and abundance of fishes, and suggests caution in use of distributional data on fishes for climatic interpretation. — *from* Author's abstract

Crowley, J. B. *See* Sorrells, G. G. 00466

00460 **Cullins, Henry L.** Geologic map of the Rangely quadrangle, Rio Blanco County, Colorado: U.S. Geol. Survey Geol. Quad. Map GQ-903, scale 1:24,000, section, text, 1971.

Oil and gas, sand and gravel, and coal occur in the map-area, but coal is not being produced as of 1968. A large part of the Rangely oil and gas field is included, and cumulative production figures are tabulated. Coal beds occur in the Williams Fork and Iles Formations and their equivalents. Stratigraphy consists of the Cretaceous Mesaverde Group which, east of Douglas Creek, is divided into the Sego Sandstone, Iles Formation, and Williams Fork Formation; west of the Creek the Group is divided into informal units. Structure contours on top of the Dakota and Castlegate Sandstones are shown on the map. — ESL

00440 **Cumming, L. M.** Abraham Gesner (1797-1864) — Author, inventor, and pioneer Canadian geologist, *in* History of Canadian Geologists: Geol. Assoc. Canada Proc., v. 23, p. 5-10, illus., portrait, 1971.

Currie, K. L. *See* Stockwell, C. H. 07971

07808 **Cvancara, Alan M.** Teredinid (Bivalvia) pallets from the Palaeocene of North America: Palaeontology, v. 13, pt. 4, p. 619-622, illus., 1970.

Well-preserved teredinid pallets (the only taxonomically useful structures) are described from borings in petrified wood of the lower and middle parts of the Cannonball Formation (early Danian) at four localities in Morton and Grant counties, south-central North Dakota; they are the oldest pallets known for North America and constitute the second occurrence in the world for the Paleocene. The Cannonball pallets establish the existence of the extant genus *Nototeredo* in earliest Paleocene. All Cannonball teredinids are included within *N. globosa* (Meek and Hayden). — *from* Author's abstract

Dahl, H. D. *See* Voight, Barry. 08056

00469 **Dainty, Anton M.** Leaking modes in a crust with a surface layer: Seismol. Soc. America Bull., v. 61, no. 1, p. 93-107, illus., table, 1971.

Dispersion curves, attenuation functions and excitation functions for an explosive source at depth for four different crust models are presented for leaking modes $P(+,-)$, $P(-,+)$ and $\pi_1(-,+)$. One objective of the calculations was to determine the effect of a surface, low-velocity layer on dispersion curves and attenuation functions. For the fundamental leaking mode, $P(+,-)$, the differences are slight, while more pronounced differences are found for other modes. Variations of the excitation function with source depth have been studied. For modes $P(+,-)$, $P(-,+)$ low frequencies are enhanced and high frequencies suppressed for one of the models as the source depth increases. Thus, a source deep in the crust should

be a more efficient exciter of the mode P(+, −), the most commonly seen mode, than a near-surface source. — DBV

Daniel, Charles C., 3d. *See* Butler, J. Robert. 00414

00413 **Daniels, R. B.; Gamble, E. E.; Wheeler, W. H.** The Goldsboro ridge, an enigma: Southeastern Geology, v. 12, no. 3, p. 151-158, illus., 1971.

The Goldsboro ridge is a sand body 25 feet high that rises above the Sunderland surface near Goldsboro, North Carolina. It consists of unfossiliferous sands with a few intercalcated clay beds. The ridge is neither an erosional outlier nor an eolian feature. It is a depositional ridge, probably of marine origin. The geography of the relationships among the height and orientation of the ridge, the elevation of the toe of the nearby Kenly scarp, the placement of a distinctive slate knoll immediately northwest of the ridge, and the position and orientation of the Neuse and Little Rivers are all compatible with a marine origin. The Goldsboro ridge and the Kenly scarp are the major evidences of a former post-Miocene sea stand above 95 feet (Surry scarp). — Authors' abstract

Davies, J. H. *See* Barringer, A. R. 07724

Davis, A. H. *See* Murphy, J. R. 00470

07869 **Davis, C. E.; Thompson, B. E.; Taylor, W. A.; Holdridge, D. A.** Dickite from Job's Hill, St. Mary, Jamaica: Clay Minerals, v. 8, no. 4, p. 461-469, illus., tables, 1970.

Examination of rock samples from Job's Hill, St. Mary, Jamaica, by chemical, X-ray, differential thermal, and infrared analyses showed predominant dickite with associated nacrite and kaolinite. The uniqueness of this deposit makes it possible that selected material could be used as a standard mineral. — Authors' abstract

00385 **Davis, George H.** Structural analysis of the Caribou sulfide deposit, Bathurst, New Brunswick [abs]: Econ. Geology, v. 66, no. 1, p. 206, 1971.

07840 **Davis, Richard A., Jr.** Prairie du Chien Group in the Upper Mississippi Valley, *in* Field trip guidebook for Cambrian-Ordovician geology of western Wisconsin — Geol. Soc. America, Ann. Mtg., Milwaukee, Wis., 1970: Wisconsin Geol. and Nat. History Survey Inf. Circ. 11, p. 35-44, illus., 1970.

Since rocks comprising this group were first described (Owen, 1840) there has been confusion and misinterpretation of the character and distribution of the stratigraphic units. A regional study of the entire Prairie du Chien Group in the Upper Mississippi Valley (Davis, in press) provides a logical and workable solution. The revised classification is based on meaningful lithologic variations in the strata; all units are easily recognized and can be traced throughout most of the outcrop area of this region. The term group is retained for the strata between the Jordan and St. Peter Sandstones, as is the name designated by Bain (1906). Summarized with photomicrographs showing textures and rock structures are the two distinct Oneota and overlying Shakopee Formations, with the Stockton Hill and Hager City, and New Richmond and Willow River members, respectively. Criteria for their distinction are outlined. — GDC

DeBremaecker, J. C. *See* Pan, Poh-Hsi. 07781

07817 **Deines, P.** The principles of spark source mass spectrography and its application to the determination of trace element concentrations: Pennsylvania State Univ. Earth and Mineral Sci. Expt. Sta. Circ. 78, 111 p., illus., 1970.

Radio-frequency source mass spectrography is a versatile, sensitive method for the determination of trace elements in liquids and organic and inorganic solids. Lowest concentration that may be determined lies in the range of 0.001 to 0.1 ppm. For the majority of elements detection limits below 3 ppb can be expected. All elements may be covered in a single analysis with about the same sensitivity, and the analytical method is linear with concentration. Bulk samples as well as surface contamination

may be analyzed. Precision is most frequently quoted as 20 percent, but precisions of 5 percent have been obtained. To obtain "true" concentration values the method requires calibration with samples of known composition. — *from* Author's summary

07883 **Denison, Robert H.** Revised classification of Pteraspididae with description of new forms from Wyoming: Fieldiana — Geology, v. 20, no. 1, p. 1-41, illus., 1970.

After studying extensive collections in the Field Museum, the author has reviewed the classification he revised in 1967, particularly the characters used to distinguish genera and species. Most of the additions concern the genus *Protaspis* and its relatives. All genera are included in the one family, Pteraspididae, with no need to raise it to an order or suborder, if *Doryaspis* is placed in a separate subfamily. Special attention is paid to structure of the branchial openings and rostral plate. The taxonomic review includes one new subfamily, two new subgenera, two new genera, and six new species. Many are illustrated. — ESL

00504 **Desautels, Paul E.** For a little bit of data, you need a big machine: Smithsonian, v. 1, no. 12, p. 46-49, illus., 1971.

The Electron Microprobe X-ray Analyzer, in use in the Smithsonian's National Museum of Natural History for six years, supplies dependable chemical analyses of samples as small as individual grains of a rock. Electrons are shot toward a mineral sample and excite atoms into emitting X-rays. Spectrometers in the head of the probe collect the X-rays and sort out and record the kinds and quantities of each. Selection of the proper crystal, and its preparation are described. The probe proved indispensable in study of meteorites and moon rocks. Rocks from the Mid-Atlantic Ridge, and deep-seated rocks carried up during formation of the diamond-bearing pipes of South Africa were also studied. — ESL

07875 **Deuser, W. G.** Hypothesis of the formation of the Scotia and Caribbean Seas: Tectonophysics, v. 10, no. 4, p. 391-401, illus., tables, 1970.

On the basis of available data it can be shown that the hypothesis of an expanding earth cannot solve space problems arising from sea-floor spreading and continental drift. It is suggested that the Caribbean and Scotia Arcs were considerably less curved when, in the movement of the continents away from the center of a pre-drift supercontinent, the perimeter of the Pacific advanced from one hemisphere to the other. Thereafter the Caribbean and Scotia Seas were formed as portions of Pacific crust, pinched out between the westward advancing and mutually approaching continents of North America and South America and South America and Antarctica, respectively. All available evidence indicates that in spite of the presence of spreading ridges in the Pacific, this ocean as a whole must still be decreasing in size. — Author's abstract

07728 **Dewart, Gilbert.** Seismic investigation of ice properties and bedrock topography at the confluence of the north and central arms of the Kaskawulsh Glacier, *in* Icefield Ranges Research Project, scientific results, V. 2 (V. C. Bushnell and R. H. Ragle, editors): New York, Am. Geog. Soc., *and* Montreal, Quebec, Arctic Inst. No. America, p. 77-102, illus., tables, modified 1970; originally published 1968.

This paper was published as Ohio State Univ. Inst. Polar Studies Rept. 27, 1968; *see* Abs. North American Geology, December 1969.

08015 **Dibblee, T. W., Jr.; Warne, A. H.** Geologic map of the Cummings Mountain quadrangle, Kern County, California: U.S. Geol. Survey Misc. Geol. Inv. Map I-611, sections, separate text, 1970.

Bedrock is mostly pre-Tertiary crystalline rocks of the Sierra Nevada granitoid batholith, overlain by Tertiary gravel in the foothills and alluvial fill in the valleys. Volcanic, plutonic, and metamorphic rocks are described. The only recognizable Quaternary faults are the White Wolf and Tejon Canyon. Prior to the Tehachapi earthquake, July 21, 1952, the White Wolf did not appear to be active, but that earthquake resulted from a slip on the fault that formed ground ruptures along much

of its course, and the Bear Mtn. block was elevated 3 or 4 feet. The Tejon Canyon fault is indicated only by the steep abrupt rise of mountains to the northeast. Summits of the mountain areas seem to be remnants of an old erosion surface. The area west of Bear and Cummings Valleys is still rising as indicated by the steep slopes and narrow V-shaped valleys. The only mineral found in commercial quantities is mercury from the Walibu mine. — ESL

08028 **Dibblee, T. W., Jr.; Louke, Gladys P.** Geologic map of the Tehachapi quadrangle, Kern County, California: U.S. Geol. Survey Misc. Geol. Inv. Map I-607, scale 1:62,500, sections, separate text, 1970.

The northern half of the quadrangle includes the southern end of the Sierra Nevada. Most of the quadrangle is underlain by pre-Tertiary crystalline rocks, composed mainly of the Sierra Nevada batholith. Valleys are filled with Quaternary alluvium. Map units described include the late Cenozoic Tehachapi, Pliocene Horned Toad, redefined Bopesta and Kinnick, and early Tertiary Witnet Formations, and plutonic and metamorphic units. Structure southeast of the Garlock fault does not conform to that on the northwest. Northeast of Tehachapi Valley is a broad synclinal structure, and a number of high-angle faults. The Garlock fault is vertical and forms a linear depression with the Tehachapi Mts. elevated along it. A total displacement of possibly 40 mi is suggested. Limestone and agates are the only products mined today. — ESL

07714 **Dieterich, James H.** Computer experiments on mechanics of finite amplitude folds: Canadian Jour. Earth Sci., v. 7, no. 2, pt. 1, p. 467-476, illus., 1970.

This study treats the plane finite deformations of models as a series of small incremental deformations. The velocity fields of the incremental problems are found by the finite element method. With single-layer models, the contrast of viscosity between the layer and matrix strongly influences the geometry of the folds at dominant wavelength. Fold geometries vary from concentric for large viscosity contrasts to nearly similar for low contrasts. In each model, the patterns given by directions perpendicular to the principal axes of maximum total compressive strain closely resemble axial-plane foliations in natural folds. Published fabric data for calcite-twin lamellae and quartz-deformation lamellae are consistent with stress directions in the theoretical models and support an interpretation that these fabric data record cumulative intragranular flow during folding. — *from* Author's abstract

Dill, Henry W., Jr. *See* Baker, Simon. 07806

07780 **Dimroth, Erich.** The evolution of the central segment of the Labrador geosyncline — Pt. 2, The ophiolitic suite (with German and French abs.): Neues Jahrb. Geologie u. Paläeontologie Abh., v. 137, no. 2, p. 209-248, illus., tables, 1970.

Pre-orogenic magmatites of the Labrador geosyncline fall into two igneous provinces: (1) Miogeosynclinal trachybasalts, andesites, and trachydolerites associated with continental red beds or marine dolomites, sandstones, and ironstones, with volcanic centers in part sub-aerial; (2) voluminous eugeosynclinal ophiolites belonging to an oceanic suite of tholeiites, spilites, and serpentinites associated with deep-sea shales and wackes. The ophiolitic magmas were enriched in iron during differentiation, but not contaminated with sialic material; their average composition is very close to deep-sea tholeiites; they were erupted during periods of rapid subsidence. Accumulation of nearly 20 km of oceanic magmatites on top of a formerly cratonized basement may constitute a special case of the transformation of continental crust into oceanic, different from sea-floor spreading. — DBV

00591 **Dionne, Jean-Claude.** Contorted structures in unconsolidated Quaternary deposits, Lake Saint-Jean and Saguenay regions, Quebec [with French and Russian abs.]: Rev. Géographie Montréal, v. 25, no. 1, p. 5-33, illus., tables, 1971.

Numerous minor deformational structures have been found in various unconsolidated Quaternary deposits, mostly in the upper beds, but some at lower levels, in the lowlands of the Lake Saint-Jean and Saguenay regions and in the adjoining

highlands of southern Quebec. Injections, involutions, folds, festoons, pseudonodules, convolutions, and various distorted laminations occur at about 40 sites. The deposits include deltaic and marine sand, silt, and silty clay, glaciolacustrine sand and silt, and fluvioglacial sand and gravel. It is believed that the contorted structures were formed at the time of deposition, by differential loading and density, slumping, and water seepage. Action of periglacial processes is considered improbable because no evidence has been found in this region of a climate, after deglaciation, cold enough to produce cryoturbation features in the soil, particularly at different levels. — VMJ

00478 **Dobrin, Milton B.** The geophysicist as a citizen: Geophysics, v. 36, no. 1, p. 184-188, 1971.

This presidential address presented at the 40th Annual International SEG meeting in New Orleans on November 9, 1970, stresses the responsibility of the geophysicist to keep himself properly informed on issues concerning the Earth and its environment, and communicate his findings to others who do not have the benefit of his background. Scientific guidance provides a sounder basis than propaganda for making wise political decisions on primarily technical issues. Aspects of environmental study where exploration geophysicists' skills are clearly applicable are discussed. — DBV

07690 **Dohler, G. C.; Ku, L. F.** Presentation and assessment of tides and water level records for geophysical investigations, *in* Symposium on recent crustal movements, Ottawa, Canada, 1969, Papers: Canadian Jour. Earth Sci., v. 7, no. 2, pt. 2, p. 607-625, illus., tables, 1970.

The methods and problems involved in collecting water level-data are explained, and the processing and formats of the data are illustrated. The trend of the change in mean water level is plotted and the corresponding rate of change is estimated by the regression technique. The power spectra of the water-level variations are plotted to illustrate these variations in terms of frequencies. — Authors' abstract

07668 **Doig, Ronald.** An alkaline rock province linking Europe and North America: Canadian Jour. Earth Sci., v. 7, no. 1, p. 22-28, illus., tables, 1970.

Lower Paleozoic carbonatites associated with the St. Lawrence graben system are correlated with carbonatites of similar age (565 m.y.) in Greenland and Scandinavia; correlation is well established in Canada where intrusions occur along a continuous rift system. Reconstruction of the whole province is made possible by restoring the continents to positions occupied prior to their separation. The combination of unique petrologic character, age, and structural setting shows these rocks belong to a single alkaline rock province, defined by a rift system extending at least from central Canada to eastern Sweden that was active throughout its length about 565 m.y. ago. Periodic intrusion of alkaline rocks occurred later, on both continents, associated with components of the fracture system. In eastern Canada, alkaline rocks occur locally with ages of 520, 450, 300, and 110 m.y. in addition to the widespread 565 m.y. event. — *from* Author's abstract

Donaldson, J. A. *See* Stockwell, C. H. 07971

Dooge, Jasper. *See* Bush, Gordon L. 07892

Dorman, James. *See* Oliver, Jack. 07687

08040 **Dort, Wakefield, Jr.; Jones, J. Knox, Jr.** (editors). Pleistocene and recent environments of the central Great Plains: Kansas Univ. Dept. Geology Spec. Pub. 3, 433 p., illus., tables, 1970.

The purpose of this symposium was to summarize in a general way work carried out in the central Great Plains region of the United States in the interrelated disciplines of anthropology, botany, geology, and zoology; to call attention to the important concept of interdisciplinary studies and to place information from a wide variety of

sources in the appropriate geographic and temporal setting; and to indicate necessary further investigations. Fourteen of the 24 papers in the symposium are cited separately. — VSN

08041 **Dort, Wakefield, Jr.** Recurrent climatic stress on Pleistocene and recent environments, *in* Pleistocene and recent environments of the central Great Plains: Kansas Univ. Dept. Geology Spec. Pub. 3, p. 3-7, 1970.

Fluctuations of glaciers are mainly the result of fluctuations of climate that can be classified as glaciations, stades, substades, and lesser pulses. The number of fluctuations that occurred during the Quaternary Period is unknown, but is undoubtedly large. Some changes may have taken place in cycles lasting only a few hundred years, and changes in adjacent areas were not necessarily either synchronous or of the same magnitude and direction. Each change in climate exerted a corresponding stress on the local environment that affected the existing population of plants, animals, and aboriginal man. — Author's abstract

00587 **Dott, Robert H., Jr.; Batten, Roger L.** Evolution of the Earth: New York, McGraw-Hill Book Company, 649 p., illus., tables, 1971.

In this textbook stress is on assumptions made by earth historians, kinds of evidence and tools available for gathering evidence, and processes of reasoning and limitations of hypotheses involved in interpreting the past. The 19 chapters discuss: terrestrial change; floods, fossils, and heresies; 'no vestige of a beginning, no prospect of an end'; relative geologic time scale and modern stratigraphic principles; organic evolution; absolute age and origin of the Earth, and its gross structure; pre- and Paleozoic history of North America; Ordovician continent; Mesozoic era; Cenozoic history of North America; Pleistocene glaciation and rise of man; tectonic history of Eurasia and of southern continents; continental displacements and the sea floor; best of all possible worlds, Three appendixes discuss fossils as organisms, synoptic classification of plants and animals; and English equivalents of metric measures. — VSN

Dott, Robert H., Sr. *See* Halbouty, Michel T. 07768

Dougherty, Verda M. *See* Rhodehamel, Edward C. 00534

07974 **Douglas, R. J. W.; Gabrielse, H.; Wheeler, J. O.; Stott, D. F.; Belyea, H. R.** Geology of western Canada, Chap. 8 *in* Geology and economic minerals of Canada: Canada Geol. Survey Econ. Geology Rept. 1 (5th edition), p. 365-488, illus., tables, 1970.

West of the Canadian Shield is the Interior Platform, underlain by Phanerozoic sedimentary rocks and covered by thick glacial drift. The mainland part of the Arctic Coastal Plain comprises Cretaceous and Cenozoic rocks of the Mackenzie Delta and other areas. The geology of the bordering part of the Arctic Continental Shelf is little known. The eastern Cordilleran Orogen, containing part of the Cordilleran Geosyncline, is divided into the Rocky Mountain Thrust Belt, arcuate Mackenzie Fold Belt, and Northern Yukon Fold Complex. In the western Orogen the Coast Plutonic Complex and Omineca Crystalline Belt, separated by the Columbian Zwischengebirge, merge northwestward to form Yukon Platform. In the south, the eastern and western Cordilleran Orogen are separated by the Rocky Mountain Trench. Bordering the Pacific Ocean are the St. Elias and Insular Fold Belts, Pacific Coastal Plain, and Continental Shelf. The Precambrian to Quaternary history of the area is described. — EH

Douglas, R. J. W. *See* Little, H. W. 07975

08007 **Douglas, R. J. W.** (editor). Geology and economic minerals of Canada: Canada Geol. Survey Econ. Geology Rept. 1 (5th edition), [V. 1] text, 838 p.; [V.2] maps and charts, 1970.

This 5th edition of the *Geology and Economic Minerals of Canada* consists of 13 chapters written by various authors from numerous government and private organizations, 12 of which are cited separately. The text deals with the four major geological

regions; the Canadian Shield and the bordering Phanerozoic platforms and orogens of southeastern, western and arctic Canada; the physiographic subdivisions; and the mineral industry. The geology and economic minerals of each of the geological regions are reviewed and separate chapters cover biochronology, Quaternary geology, and ground-water geology for the country as a whole. An accompanying folio contains a geotectonic correlation chart for each region and 8 maps at 1:5 million scale covering geology, tectonics, mineral deposits, glacial features, physiographic regions, isotopic ages, and magnetic and gravity anomalies. — EH

Drake, Charles L. *See* Mayhew, Michael A. 07700

08019 **Dran, J. C.; Durrieu, L.; Jouret, C.; Maurette, M.** Habit and texture studies of lunar and meteoritic materials with a 1 MeV electron microscope: Earth and Planetary Sci. Letters, v. 9, no. 5, p. 391-400, illus., 1970.

Some habit and texture features of the finest and uncrushed grains in lunar samples 10084 and 12070 were compared with those observed in broken fragments from rocks 10047 and 12063 or from different types of meteorites. The finest fraction of the Apollo 11 samples is constituted of about 80 percent well ordered but rounded crystals which are frequently overlaid by a thin skin of amorphous material. In the Apollo 12 soil the grains are coarser, the fraction of crystalline material is higher and the proportion of crystals showing an amorphous skin is smaller, but both lunar soils are very different from meteoritic or lunar rock matter. Some implications of the present results concerning the fabric of the finest fraction of the lunar regolith, the ancient solar wind, and meteoritic research are briefly outlined. — *from* Authors' abstract

08042 **Dreeszen, Vincent H.** The stratigraphic framework of Pleistocene glacial and periglacial deposits in the Central Plains, *in* Pleistocene and recent environments of the central Great Plains: Kansas Univ. Dept. Geology Spec. Pub. 3, p. 9-22, illus., table, 1970.

Classification of the Pleistocene deposits in the Central Plains appears to be in a process of evolution. Evidence that continental glaciation was complex and that each major glacial period included multiple advances in accumulating. Moreover, the concept of four major glaciations separated by distinct interglacial periods needs reexamination. Problems of correlation between deposits related to continental sheets of glacial ice and those related to streams, probably in part rejuvenated by crustal adjustment, remain to be solved. The precision of correlation of Pleistocene deposits in the Central Plains with those of other geographical areas diminishes beyond the reach of radiocarbon dating. Greater precision will require interdisciplinary action among Pleistocene scientists and a considerable attention to subsurface data. — Author's abstract

07738 **Dresch, Jean.** A propos du désert de Chihuahua [The Chihuahua desert]: Annales Geographie, v. 79, no. 431, p. 51-57, illus., 1970.

The so-called Chihuahua desert in northern Mexico is really a high semi-desert, separated from the Sonoran and Lower Californian deserts by the western Sierra-Madre. It is composed of discontinuous, poorly-drained high plains, some of them closed basin. The climate, drainage, geology, soils and vegetation of the area are described. — EH

00386 **Dreyer, Robert M.** Evaluation of deposits for use as concrete aggregate [abs]: Econ. Geology, v. 66, no. 1, p. 206, 1971.

07920 **Duffield, Lathel Flay.** Some Panhandle Aspect sites, their vertebrates and paleoecology [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 31, no. 6, p. 3123B-3124B, 1970.

00580 **Dunn, David L.** Considerations of the *Idiognathoides-Declinognathodus-Neognathodus* complex of middle Carboniferous platform conodonts: Lethaia, v. 4, no. 1, p. 15-19, illus., 1971.

An hypothesis proposed by Straka and Lane (1970), suggesting *Idiognathoides noduliferus* and *I sulcatus* as joint progenitors of a morphologically interrelated group of Lower Pennsylvanian (Morrowan) conodonts (western U.S.), is here considered unnecessarily complex and based on insufficient data. In a more simple interpretation, based on phylogenetic, ontogenetic, and stratigraphic considerations, it is suggested that: the *Idiognathoides sinuatus* (and/or *I. opimus*)-*I. sulcatus* (and/or *I opimus*) group descended from *Gnathodus defectus; Neognathodus bassleri* descended from *Declinognathodus noduliferus* through *D. lateralis; D. noduliferus* (transferred from *Idiognathoides*) and *G. defectus* shared the common ancestor *Gnathodus gurtyi simplex*. — *from* Author's abstract

Durrieu, L. *See* Dran, J. C. 08019

Eagon, Herbert B., Jr. *See* Norris, Stanley E. 00403

00506 **Earthquake Information Bulletin.** Man's seismic ear is sharpened at this laboratory in the desert: Earthquake Inf. Bull., v. 3, no. 1, p. 20-23, illus., 1971.

The National Ocean Survey's Albuquerque Seismological Laboratory, established in July 1961 south of Albuquerque, New Mexico, is described. Although it is also a seismic observatory, its prime mission is "to improve seismic systems, design new devices and calibrate and repair instruments for seismic stations around the world." Thus it is a research development and field maintenance branch of the NOS which furnishes equipment and support to the 115 worldwide seismograph stations. Its testing, data-processing, and systems-engineering functions and facilities are described. Systems have been developed for early warning tsunami control, aftershock and vibration studies, monitoring underground nuclear explosions, and many other operations. — EH

07882 **Earthquake Notes.** A note on the San Fernando, California, earthquake of February 9, 1971: Earthquake Notes, v. 41, no. 4, p. 44, 1970 [1971].

A major earthquake occurred on February 9, 1971 at 34°23.8′ N., 118°23.6′ W., along the Soledad Canyon fault in California. Magnitude on the Richter scale was 6.5. The shock was felt over a 30,000 sq mi area, there was major damage to buildings, dams, highways, and railroads, and it resulted in 53 deaths. The most unique aspect of the shock is the high accelerations measured. The accelerogram at Pacoima Dam near the epicenter, indicates a single peak acceleration of 1 g, the largest ever recorded for an earthquake. During the first 12 sec, ground motions of 0.5 to 0.7 g occurred. — VSN

Edgerton, A. T. *See* Meier, M. 08076

07810 **Edwards, Jonathan, Jr.** Deep wells of Maryland: Maryland Geol. Survey Basic Data Rept., no. 5, 162 p., illus., table, 1970.

This report is primarily a catalog of 349 deep wells in Maryland and provides an accessible source of deep stratigraphic data in the State. Wells listed include 162 drilled for oil or gas, 39 for gas storage injection, 21 to test geologic structures or for gas storage, 88 water wells, 21 stratigraphic tests, and 8 core holes. Every oil or gas well drilled in Maryland is listed, regardless of depth, but only water wells of depth greater than 1,000 feet are included, except where more shallow wells provide significant stratigraphic information. Locations of wells are shown on a map. The listing of wells gives for each the well name, location, date drilled, surface elevation, depth, geologic formations encountered, geophysical logs and chemical analyses when available, and remarks and references. — VSN

Eggert, D. A. *See* Rothwell, G. W. 07902

07921 **Eggleton, Richard Elton.** Recognition of volcanoes and structural patterns in the Rümker and Montes Riphaeus quadrangles of the Moon [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 31, no. 6, p. 3479B, 1970.

07686 **Eisbacher, G. H.; Bielenstein, H. U.** Interpretation of elastic-strain-recovery measurements near Elliot Lake, Ontario, *in* Symposium on recent crustal movements, Ottawa, Canada, 1969, Papers: Canadian Jour. Earth Sci., v. 7, no. 2, pt. 2, p. 576-578, illus., 1970.

In situ stresses obtained by measurements of elastic-strain-recovery in quartzose sedimentary rocks near Elliot Lake are interpreted in terms of two stress environments: one stress field induced by mining close to the mine openings and a remanent stress field preserved in the rocks from a time of tectonic deformation in the area. — Authors' abstract

07701 **Eisbacher, G. H.** Contemporaneous faulting and clastic intrusions in the Quirke Lake Group, Elliot Lake, Ontario: Canadian Jour. Earth Sci., v. 7, no. 2, pt. 1, p. 215-225, illus., 1970.

Contemporaneous faults and clastic intrusions near Elliot Lake are common within the Espanola Formation of the Quirke Lake Group. Contemporaneous faults formed in response to differential vertical displacements which controlled regional paleocurrents and basin slope. The normal faults within the sedimentary succession probably channeled the intrusive material of the clastic dikes. Four types of clastic dikes occur in the Espanola Formation: internally sorted conglomerate dikes; internally unsorted conglomerate dikes; thin sand- and siltstone dikes; and discordant sandstone masses with scattered quartz pebbles. Emplacement of the conglomerate masses into the Espanola Formation may represent a sub-permafrost phenomenon, provided the glacial origin for the boulder conglomerates within the Huronian succession is accepted. — Author's abstract

07922 **Eittreim, Stephen Lawrence.** Suspended particulate matter in the deep waters of the northwest Atlantic Ocean [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 31, no. 6, p. 3490B, 1970.

07901 **Elloy, R.; Tixier, M.** Phénomènes sédimentaires et diagénetiques en milieu de dépot haut-intertidal a supratidal dans la Silurien du forage de Pen 1, Ontario (Canada) [Sedimentary and diagenetic phenomena of a high-intertidal and supratidal depositional environment in the Silurian of the Pen 1 bore hole, Ontario (Canada) (with French and English abs.)]: Centre Recherches Pau Bull., v. 4, no. 2, p. 465-483, illus., 1970.

This paper deals with some sedimentary and diagenetic features observed in core samples of Pen 1 borehole, Hudson Bay, Ontario. The sediments studied are interpreted as being deposited in the high intertidal to supratidal zone; the great development of stromatolitic algae directly influences the sedimentation. In this environment the stromatolitic algal mats were apparently exposed to atmospheric influences such as desiccation producing sometimes an early lithification. In some cases these processes were followed by the crumbling of the algae mats into pellets. It is believed that the porosity of the sediments is a direct consequence of these diagenetic processes. — *from* Authors' abstract

07981 **Emry, Robert J.** A North American Oligocene pangolin and other additions to the Pholidota: Am. Mus. Nat. History Bull., v. 142, art. 6, p. 455-510, illus., 1970.

The family Manidae heretofore has comprised: seven species of living pangolins of Asia and Africa, here all placed in *Manis*; two extinct Pleistocene species of *Manis* from Asia, and one from Europe; at least four Oligocene-Miocene European species in *Necromanis*, *Leptomanis*, *Teutomanis*. *Patriomanis americanus* is a new genus and species from the early Oligocene volcanic ash F of the "White River" formation north of Alcova, Natrona County, Wyo. Comparison of this new form with edentates and early Tertiary North American palaeanodonts furnishes evidence that the manids are derived from the metacheiromyids and originated in North America. A new classification of the order Pholidota includes, besides the Manidae, the two palaeanodont families, Metacheiromyidae and Epoicotheriidae, transferred from the Edentata. — VMJ

Emslie, R. F. *See* Stockwell, C. H. 07971

00424 **Erdtmann, Bernd-D.** *Tetragraptus otagoensis* and *Janograptus terranovensis*, n.sp., Ordovician graptolites from western and northern Newfoundland: Jour. Paleontology, v. 45, no. 2, p. 258-264, illus., table, 1971.

Tetragraptus otagoensis (Benson and Keble) is described and illustrated from the Early Ordovician Cow Head Group at Martin Point, western Newfoundland. The graptolite fauna associated with this species occurs at Levis, Quebec, and Marathon, Texas. A new species, *Janograptus terranovensis*, of a genus not previously known from North America, is described and illustrated from the Goose Tickle Formation, Hare Bay, northern Newfoundland; associated biserial graptolites indicate early Middle Ordovician age. This assemblage has strong affinities with a fauna of the Upper Didymograptus Shales of the Oslo region, Norway, and of southern Sweden. — JWH

Erickson, Barrett H. *See* Rea, David K. 00560

07712 **Ermanovics, I. F.** Zonal structure of the Perth Road monzonite, Grenville Province, Ontario: Canadian Jour. Earth Sci., v. 7, no. 2, pt. 1, p. 414-434, illus., tables, 1970.

The Perth Road monzonite is zoned and from the center outward comprises gabbro, diorite, monzonite, quartz monzonite, and granite. The change from one to another is gradual and the progressive acidification toward all contacts demonstrates co-genesis. The enclosing crystalline metasedimentary rocks have been metamorphosed to the hornblende granulite facies, and although recrystallization has kept pace with deformation, some cataclasis pervades all rocks. Flow models demonstrate that the early magmatic precipitates collected in regions of maximum velocity of the magma during folding of the enclosing envelope of gneisses and that the syntectonic differentiation in this manner obtains for the Perth Road and other plutons in the area. — *from* Author's abstract

00387 **Everhart, Donald L.** Evaluation of phosphate rock deposits [abs]: Econ. Geology, v. 66, no. 1, p. 207, 1971.

Ewing, John. *See* Stoll, Robert D. 00547

00540 **Fabbi, Brent P.** Rapid X-ray fluorescence determination of phosphorus in geologic samples: Appl. Spectroscopy, v. 25, no. 1, p. 41-43, illus., table, 1971.

Calcium $K_{beta\text{-}1}$ and $K_{beta\text{-}5}$ both have second order (II) lines that interfere spectrally with the phosphorus $K_{alpha\text{-}1}$ first order (I) analytical line in the X-ray fluorescence determination. By combining maximum pulse height discrimination with a mathematical correction for peak overlap, phosphorus can be accurately determined in a wide variety of geologic samples. — Author's abstract

08034 **Fagerstrom, J. A.** Cryptalgal structures in the Detroit River Group (Devonian), southwestern Ontario: Canadian Jour. Earth Sci., v. 7, no. 2, pt. 1, p. 548-550, 1970.

Four principal morphologic forms of cryptalgal structures are present in the dolomite rocks of the Detroit River Group in southwestern Ontario: domal stromatolites, polygonal stromatolites, and two types of cryptalgalaminate structures. These features in association with birdseye structures and molds of evaporite crystals strongly suggest that the rocks were deposited between the upper subtidal and lower supratidal zones of a hypersaline sea in the Michigan Basin. — Author's abstract

Fahrig, W. F. *See* Stockwell, C. H. 07971

Faill, R. *See* Lapham, D. M. 00523

00567 **Fairbairn, H. W.; Hurley, P. M.** Evaluation of X-ray fluorescence and mass spectrometric analyses of Rb and Sr in some silicate standards: Geochim. et Cosmochim. Acta, v. 35, no. 2, p. 149-156, illus., tables, 1971.

X-ray fluorescence analysis of Rb and Sr in five rock standards, using computed mass absorption corrections, agrees satisfactorily with mass spectrometer results. Com-

parable agreement is found by averaging Rb and Sr values obtained with matrix corrections based on the reciprocals of Compton scaller and background intensity. — Authors' abstract

Fairhurst, C. *See* Rummel, F. 07779

Farmanfarmaian, A. *See* Schopf, Thomas J. M. 00422

07829 **Faure, Jean.** Study of the mineralogical transformations of granite by underground nuclear explosions, *in* Symposium on engineering with nuclear explosives — Am. Nuclear Soc. and U.S. Atomic Energy Comm., Las Vegas, Nev., 1970, Proc., V. 2: Springfield, Va., Clearinghouse Federal Sci. and Tech. Inf., p. 1406-1427, illus., tables, 1970.

New data on the petrographic effects of underground nuclear explosions are presented on the basis of results of tests in granite in the Hoggar, Algeria. Samples were collected by drilling and temperature of the rock was measured in the hole. Melted rock types produced by the explosions include grey-green glass and pumices, beige to red-brown pumices, partially melted granite and dark lavas, and dark veinlets and crushed granite. Distribution of these types in relation to the shot point, and results of optical microscopy, X-ray and chemical analysis, and electron-probe studies are discussed. The presence of low cristobalite and sanidine and the diffusion of elements in a short distance indicate the importance of thermic phenomena. Coesite and stishovite do not appear. — VSN

00372 **Field, Cyrus W.; Moore, William J.** Sulfur isotope study of the "B" limestone and Galena fissure ore deposits of the U.S. mine, Bingham mining district, Utah: Econ. Geology, v. 66, no. 1, Bateman issue, p. 48-62, illus., tables, 1971.

Sulfides of the "B" limestone (replacement ores) and Galena fissure, like those of the Bingham porphyry copper, cluster closely around the zero permil value of meteoritic sulfur. In detail, there is increasing enrichment in S-34 outward from lowest values in the central porphyry deposit, intermediate in the "B" limestone, and highest in the Galena fissure deposits. Both limestone and fissure deposits show increasing S-34 depletion in the sequence pyrite, sphalerite, tetrahedrite, and galena. Delta values (difference between isotope ratios) for coexisting sulfide pairs increase with altitude. The relations are consistent with fractionation effects due to a district-wide temperature gradient. Upward depletion of S-34 is provisionally attributed to Eh-pH control. — WSW

Filby, R. H. *See* Shah, K. R. 07850

00454 **Finch, Warren I.** Geologic map of part of the Hickman quadrangle, Fulton County, Kentucky, and Mississippi County, Missouri: U.S. Geol. Survey Geol. Quad. Map GQ-874, scale 1:24,000, sections, tables, text, 1971.

Bedrock contours on an erosional surface cut on Eocene rocks are included on the map. The Cenozoic column is described in detail. Chief resources are gravel and ground water, with clay as a potential resource. Engineering properties of materials at the site for the proposed water treatment plant southwest of Hickman were investigated and consisted of alluvium, loess, gravel, and the Tertiary Jackson Formation. Landslides have occurred along the steep bluff, some prehistoric, and some as recent as 1962. Ground water seeping out of thin gravel layers keeps the hillside continuously wet. Preparation of a large-scale engineering geology map of the bluff area of the town is recommended. The quadrangle is in a major earthquake belt and the Madrid earthquake was centered about 25 mi from the town. Evidence was found for a large fault in the Mississippi Valley and several smaller ones in the quadrangle. — ESL

Fisher, D. E. *See* Bonatti, Enrico. 00570

Fisher, W. L. *See* Brown, L. F., Jr. 08003

07997 **Flawn, Peter T.** Environmental geology — What is the responsibility of the science?, *in* Environmental geology – AGI short course lecture notes, Milwaukee, Wis., 1970: Washington, D. C., Am. Geol. Inst., [8] p., paged separately, 1970.

The author defines environmental geology as that field in which geology is applied to environmental problems. It is the responsibility of geologists to provide geologic information in useable form to planners, administrators, and policy-makers. At present geologic maps and information on rates of geologic processes are insufficient to meet the needs of environmental geologists, and there is a need for a systems approach to geology in order to develop a predictive model. Teachers should be required to take at least one course providing basic information about the environment, and college geology departments have a responsibility to provide the average citizen with knowledge and understanding of the Earth. — EH

00452 **Fok, Yu-Si.** Law of stream relief in Horton's stream morphological system: Water Resources Research, v. 7, no. 1, p. 201-203, table, 1971.

Within a river basin, the streams can be classified by the Horton-Strahler stream order system. In 1945, Horton introduced the law of stream lengths and the law of stream slopes and found the average stream lengths and slopes as semilogarithmic functions of the stream order. In this study, paralleling Horton's development, the law of stream relief is proposed and the average stream relief is found also to be a semilog function of the stream order. Results from numerical analysis indicate that the riverbed profile can be described by a semilog equation expressing stream relief as a function of stream length. The F value in the stream relief equation may be considered as an indicator of the riverbed profile properties; however, more investigations are needed before any conclusive statements can be made. — Author's abstract

Folk, Robert L. *See* Pittman, J. S. 00603

07837 **Forgotson, James M., Jr.; Stark, Philip H.** Well data files and the computer exploration tools for the 70's, *in* Exploration concepts for the Seventies: Gulf Coast Assoc. Geol. Socs. Trans., v. 20, p. 115-122, illus., 1970.

More than 600,000 wells are included in 9 computer-processable well data systems covering most of the United States and Canada. Well data files are used at various stages of exploration for basin evaluation, selection of prospective stratigraphic intervals and areas for further study, delineating prospects for acreage acquisition or drilling, and for building perpheral files containing proprietary, technical, and economic data. A study of the Muddy play in the Powder River basin illustrates an exploration application of computer processing of a large well data file. Such files and proper computer application will become increasingly important in the discovery of oil and gas during the 1970's. — DBV

Forward, Robert L. *See* Bell, Curtis C. 07995

00400 **Foster, R. L.** Cation exchange capacity and metal deposition — A suggestion [discussion of paper by A. S. Radtke and B. J. Scheiner, 1970]: Econ. Geology, v. 66, no. 1, Bateman issue, p. 200-201, 1971.

Syngenetic clay mineral assemblages may, because of their exchange capacity, play an important role in genesis of very fine-grained gold deposits. For original paper, *see* ibid., v. 65, no. 2, p. 87-102; Abs. North American Geology, March 1971. — WSW

Franks, Paul C. *See* Bayne, Charles K. 00583

Franzmeier, D. P. *See* Lynn, W. C. 00410

07667 **Frebold, Hans; Tipper, H. W.** Status of the Jurassic in the Canadian Cordillera of British Columbia, Alberta, and southern Yukon: Canadian Jour. Earth Sci., v. 7, no. 1, p. 1-21, illus., table, 1970.

Jurassic index fossils of the Canadian Cordillera indicate the presence of some zones of most Jurassic stages. In this report the more important localities are listed, the source of information, published and unpublished, is indicated, and an up-dated correlation chart is presented. The importance of tectonic events and their effect on the completeness of the Jurassic fossil record and on the Jurassic paleogeography are stressed. — Authors' abstract

00388 **Freeman, William G.** Evaluation of barite deposits [abs]: Econ. Geology, v. 66, no. 1, p. 207, 1971.

00551 **Frey, Frederick A.; Haskin, Larry A.; Haskin, Mary A.** Rare-earth abundances in some ultramafic rocks: Jour. Geophys. Research, v. 76, no. 8, p. 2057-2070, illus., tables, 1971.

A survey has been made of the abundances of the rare earths (REE) in ultramafic rocks. Samples analyzed were taken from alpine regions, layered intrusions, basaltic nodules, and kimberlite pipes. A wide range of REE concentrations and relative abundances was found. Crystal chemical restrictions and type of field occurrence appear to affect REE abundances in ultramafic rocks. Kimberlites are characteristically quite enriched in the light REE compared to the REE distribution in chondritic meteorites. The only ultramafic rocks found to be relatively depleted in the light REE were those from some of the alpine environments sampled. Some ultramafic rocks from layered intrusions had nearly chondritic REE distributions. — Authors' abstract

07870 **Frey, Robert W.** Trace fossils of Fort Hays Limestone Member of Niobrara Chalk (Upper Cretaceous), west-central Kansas [with German abs.]: Kansas Univ. Paleont. Contr. Art. 53 (Cretaceous 2), 41 p., illus., tables, 1970.

Trace fossils are abundant and diverse, though poorly preserved, in the Fort Hays Limestone. The fauna consists of at least 20 taxonomic and ethologic variants distributed among 13 genera. Forms which cannot be assigned to distinctive genera include cylindrical shafts and filled burrows; about 65 percent of these represent dwelling structures; no tracks or trails were observed. Distribution and abundance of several fossils are correlative with distinct lithotypes, and composition changes gradually upward. Evidence indicates that, except for brief influxes of terrigenous detritus, the carbonate muds accumulated slowly; the substrate was soft to a considerable depth; both sediments and water were well aerated; currents capable of substrate scour and shell-fragment transport were common; and sediments accumulated initially in shallow water, which deepened gradually. — *from* Author's abstract

Friedman, Gerald M. *See* Gevirtz, Joel L. 00418

07715 **Friedman, M.; Sowers, G. M.** Petrofabrics, a critical review: Canadian Jour. Earth Sci., v. 7, no. 2, pt. 1, p. 477-497, illus., table, 1970.

Petrofabric contributions are classified into seven categories, namely: descriptive techniques, kinematic analyses, geometric analyses of folds, absolute strain analyses, studies of experimentally deformed single crystals and rocks, dynamic analyses of deformation features in naturally deformed rocks, and studies for engineering rock mechanics. The nature of each subfield is given, and kinematic analyses and dynamic analyses of deformation features in naturally deformed rocks are discussed in detail. — *from* Authors' abstract

08079 **Froese, E.** Chemical petrology of some pelitic gneisses and migmatites from the Thor-Odin area, British Columbia: Canadian Jour. Earth Sci., v. 7, no. 1, p. 164-175, illus., tables, 1970.

The gneiss dome in the Thor-Odin area of the Shuswap metamorphic terrain of British Columbia, has a core of migmatites and granitoid gneisses surrounded by a mantle of unmigmatized gneisses. Rocks of both zones belong to the sillimanite-almandine-orthoclase subfacies of the almandine-amphibolite facies. A common mineral assemblage in pelitic gneisses and migmatites is quartz + plagioclase + K feldspar + biotite + garnet + sillimanite, related by the reaction biotite + sillimanite +

quartz + garnet + K feldspar + water. This reaction is used as a measure of water pressure-temperature conditions. Variations of biotite and garnet composition indicate differences in conditions of quenching. Migmatites from the core zone reflect either a higher water pressure at constant T or a lower T at constant water pressure than mantling gneisses; the second is the more probable. A higher water content in core rocks might account for migmatization and for somewhat lower quench temperature. — *from* Author's abstract

00584 **Frye, John C.** A geologist views the environment: Illinois Geol. Survey Environmental Geology Note 42, 9 p., 1971.

The geologist necessarily has a broad and long-term view of the environment. Although natural modifications of the Earth have generally taken place over long periods of time, man has produced changes within days, some of which were thought to be desirable but which proved undesirable. The contributions of earth scientists to solving these problems are: (1) collection of data for planning proper use of the land, (2) determination of factors influencing safety and permanence of waste disposal, (3) provision of information for planning and development of water supplies, (4) identification of rock and mineral resources, (5) recognition of man as a major geologic element and consequent monitoring and remedying of changes he has caused. — EH

Fuller, D. L. *See* Gann, E. E. 00535

00471 **Furumoto, Augustine S.; Campbell, J. Frisbee; Hussong, Donald M.** Seismic refraction surveys along the Hawaiian Ridge, Kauai to Midway Island: Seismol. Soc. America Bull., v. 61, no. 1, p. 147-166, illus., tables, 1971.

Seismic refraction data from 18 traverses along the Hawaiian Ridge from Kauai to Midway Island are presented in this paper. The seismic velocities of the mantle vary from 7.8 kmps to 8.8 kmps. The velocity of the lower layer of the crust tends to cluster around 6.5 kmps. The velocities of the upper crustal layers vary from 4.0 to 5.7 kmps without tendency to cluster around any value. The depth to the mantle along the Leeward Islands is usually between 10 and 15 km. The mantle is deeper (18 km) near the major islands. From the data, inference is drawn that the area of subsidence was smaller for older volcanic islands than for the newer ones. An hypothesis based on fluid dynamics of inverted densities is proposed to account for this. — Authors' abstract

Fyles, J. G. *See* Mathews, W. H. 07694

Gabrielse, H. *See* Douglas, R. J. W. 07974

08031 **Gabrysch, R. K.; Bonnet, C. W.; Naftel, W. L.** (compilers). Records of water-level measurements in wells in Harris County, Texas, 1966-69: Texas Water Devel. Board Rept. 122, 65 p., illus., table, 1970.

This report is the second in a series, continuing measurements published by the Texas Water Development Board as Rept. 103 (1969). This report presents measurements made since 1966, for the most part from the same wells, although a few new ones have been added. The tabulations are photographic reproductions of direct printouts of the electronic data processing systems used for the recorded water-level data, referenced to land surface. With a new 7-digit numbering of wells developed for use throughout the state, previously published "old well numbers" are included to provide a means of cross reference to the earlier well data. On the well-location map, only the last three digits of the new number are shown for each site. — GDC

07689 **Gale, L. A.** Geodetic observations for the detection of vertical crustal movement, *in* Symposium on recent crustal movements, Ottawa, Canada, 1969, Papers: Canadian Jour. Earth Sci., v. 7, no. 2, pt. 2, p. 602-606, illus., tables, 1970.

The significant limits within which crustal movement can be determined by geodetic survey methods depend on the quality of the observations, the stability of the mar-

kers in the network, and the structure of the network. This paper presents a study of vertical movement in the Lac St. Jean area of Quebec. The data used covers the periods 1919-1938 and 1962-1966. With reference to a line of levels from Ste. Anne de la Pérade to La Malbaie along the north shore of the St. Lawrence River, the results show annual uplift as high as 10 mm at Seneterre and subsidence amounting to 4 mm at Stoneham, north of Quebec City. Confidence intervals, at the 95 percent level, for rates of movement are given as indicators of the quality of the results. — Author's abstract

Gamble, E. E. *See* Daniels, R. B. 00413

00535 **Gann, E. E.; Harvey, E. J.; Jeffery, H. G.; Fuller, D. L.** Water resources of northeastern Missouri: U.S. Geol. Survey Hydrol. Inv. Atlas HA-372, 4 sheets, block diagram, maps, tables, 1971.

The four sheets cover the following: (1) physical setting and water system, (2) ground-water availability and quality, (3) surface-water availability and quality, and (4) water-resources evaluation, floods, and water use. — ESL

07923 **Gans, William Thomas.** The detailed stratigraphy of the Goodsprings Dolomite, southwestern Nevada-California [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 31, no. 6, p. 3479B-3480B, 1970.

Gasparini, Paolo. *See* Adams, John A. S. 07859

07763 **Gatewood, Lloyd E.** Oklahoma City field — Anatomy of a giant, *in* Geology of giant petroleum fields — Symposium, AAPG, 53d Ann. Mtg., Oklahoma City, Okla., 1968: Am. Assoc. Petroleum Geologists Mem. 14, p. 223-254, illus., tables, 1970.

This oil and gas field, discovered in 1928 by a wildcat well, today is a 1000-ft closure of at least 30 different producing zones in a 32 sq-mi area. Arbuckle dolomite, Ordovician, on crest of the structure beneath Pennsylvanian unconformity was the first; Simpson-Wilcox sandstone, the most prolific, has produced 537.5 million bbl of oil or 50 percent of the estimated 1.07 billion bbl in place. The field is near the south end of the buried Nemaha ridge, at its intersection with Anadarko basin, coinciding with a series of shelf-edge hinge zones. The structure was folded, faulted, and truncated contemporaneously; about 2000 feet of Ordovician-Pennsylvanian strata was removed from the top. Lateral oil migration was prevented by a large down-to-east fault on the northeast rim, and limited upward by the unconformity and overlying shale. Oil accumulated in pinchouts, fault traps, and channel deposits in shallow Pennsylvanian zones on a very irregular buried surface. — GDC

Geldart, L. P. *See* Sharma, Bijon. 07717

00418 **Gevirtz, Joel L.; Park, Richard A.; Friedman, Gerald M.** Paraecology of benthonic Foraminifera and associated micro-organisms of the continental shelf off Long Island, New York: Jour. Paleontology, v. 45, no. 2, p. 153-177, illus., 1971.

A paraecologic study of Recent micro-organisms, especially benthonic Foraminifera (91 species, including 67 found living), of the continental shelf off Long Island, New York, permits the differentiation of nine biofacies, of which five represent shelf environments and four characterized upper bathyal (slope) environments. Temperature seems to be the dominant factor controlling benthonic foraminiferal distribution. The sample area is divided into four biotopes containing inner shelf, middle shelf, outer shelf, and slope faunas; a faunal break between outer shelf and slope species is attributed to the confluence of cold, lower salinity shelf waters with the warmer, more saline water of the slope. Relict faunas indicate a stillstand of sea level at 35 fathoms. Biofacies and biotopes were determined by cluster analysis. Evaluations of empty foraminiferal tests permit valid interpretations of late Pleistocene history. — *from* Authors' abstract

07675 **Gibb, R. A.; vanBoeckel, J.** Three-dimensional gravity interpretations of the Round Lake batholith, northeastern Ontario: Canadian Jour. Earth Sci., v. 7, no. 1, p. 156-163, illus., table, 1970.

Gravity surveys of the Timmins-Senneterre mining belt of northeastern Ontario and western Quebec, in 1946-64, revealed Round Lake batholith is one of several composite granitic plutons of the Algoman series outlined by intense negative gravity anomalies; the anomaly over the batholith can be explained by the large density contrast (0.22 g/cm^3) between the granite and surrounding Keewatin volcanic rocks. Two possible models of the batholith which depend on different assumptions as to composition of the upper crust are presented. The first involves normal faulting of the batholith to explain variations in anomaly level within the batholith; granite is assumed to be homogeneous in density and extends to a maximum depth of 10 km. Alternatively density variations corresponding to a facies change within the pluton may be the major cause of local internal anomaly variations. True granite thickness cannot be evaluated, but maximum thickness of surrounding basic volcanic rocks is 5 km. — *from* Authors' abstract

07895 **Gibson, D. W.** Triassic stratigraphy, Pine Pass area, northeastern British Columbia, *in* Peace River, Pine Pass, Yellowhead 1970 — Edmonton Geol. Soc. Field Conf., 12th, Guidebook: Edmonton, Alberta, Edmonton Geological Society, p. 23-38, illus., 1970.

Triassic stratigraphy is discussed for the Rocky Mtn. Foothills between Peace and Sukunka Rivers in general and in the Peace River-Pine Pass and Pine Pass-Sukunka River areas in particular; a nomenclature and correlation chart is included. Some units north of John Hart Highway and Pine Pass cannot be extended to the south. It is proposed that part of the Triassic nomenclature used in the Jasper-Banff area of Alberta be modified and applied to Lower and Middle Triassic outcropping between John Hart Highway and Sukunka River. — ESL

00515 **Gibson, Thomas G.; Towe, Kenneth M.** Eocene volcanism and the origin of horizon A: Science, v. 172, no. 3979, p. 152-154, illus., 1971.

A series of closely time-equivalent deposits that correlate with seismic reflector horizon A exists along the coast of eastern North America. These sediments of late-early to early-middle Eocene age contain an authigenic mineral suite indicative of the alternation of volcanic glass. A volcanic origin for these siliceous deposits onshore is consistent with a volcanic origin for the cherts of horizon A offshore. — Authors' abstract

Gill, D. E. *See* Sharma, Bijon. 07717

07986 **Gillard, Douglas R.; White, Wilbert I.** Plato Viking Pool — Reservoir engineering and geological study: Jour. Canadian Petroleum Technology, v. 9, no. 4, p. 227-236, illus., 1970.

The Plato Viking Pool is 40 miles southwest of Kindersley, Saskatchewan; of about 70 wells drilled to date, 50 have been classified as oil producers. The reservoir comprises two distinct sand layers, the upper "A" and the lower "B", separated by 10-15 feet of shale; the "A" sand is the main oil-bearing section, with the possible contribution of "B" much in question. Ultimate primary recovery is estimated to be 2.4 million bbls, equivalent to 12.8 percent of oil-in-place in the "A" sand. Because of severe pressure depletion caused by the undersaturated state of the reservoir, it is recommended that waterflood operations begin at an early date. Ultimate recovery under waterflood is estimated to be 4.8 to 6.2 million bbls. If field tests prove it feasible to waterflood "B" sand also, this recovery could be exceeded. — *from* Authors' abstract

07988 **Gillespie, J. B.; Green, D. W.; Slagle, S. E.** Artificial ground-water recharge, Wet Walnut Creek, central Kansas: Kansas Water Resources Board Prog. Rept. 2, 28 p., illus., tables, 1970.

The capability to artificially recharge the alluvial aquifer underlying Wet Walnut Creek valley, central Kansas, was tested at two sites — one an alluvial slope near the edge of the valley and the other a shallow tributary channel with ephemeral flow. A study of the natural recharge mechanism along the main stem of the creek is planned. Most of the site-development work is finished except the dam for pond 1 at the tribu-

tary-channel site. Experiments at the alluvial-slope site indicate that after water pumped from wells has been ponded several days, the infiltration rate is about 0.5 feet per day. The infiltrated water is perched above a zone of silty clay from where it is assumed to percolate to the aquifer. Experiments at the tributary-channel site indicate infiltration rates vary with different channel-bottom conditions. — Authors' abstract

07812 **Girard, G.** Essai pour un modèle hydropluviométrique conceptuel et son utilisation au Québec [A conceptual hydropluviometric model and its use in Quebec]: [France] Office Recherche Sci. et Tech. Outre-Mer Cahiers, Sér. Hydrologie, v. 7, no. 2, p. 85-116, illus., 1970.

The author's aim was to reconstitute a theoretical flood caused by a downpour in a drainage basin, defined by a series of parameters, by means of a model which can explain mechanisms of discharge of rain or snow-melt, of infiltration, evapotranspiration, and baseflow, in relation to the physical characteristics of the basin and to hydrological factors. This study is a methodological rather than an operative model. — EH

Gleason J. D. *See* Gunter, B. D. 00528

00446 **Globensky, Yvon; Jauffred, Jean-Claude.** Stratigraphic distribution of conodonts in the Middle Ordovician Neuville section of Quebec [with French abs.]: Geol. Assoc. Canada Proc., v. 23, p. 43-68, illus., tables, 1971.

Of about 2500 conodont specimens, from the Neuville section of the Trenton limestone, St. Lawrence Lowland of Quebec, 25 genera and 39 form species have been identified. Four of Bergström and Sweet's multielement species, grouping 12 form species, have been recognized representing 95 percent of the fauna: *Phragmodus undatus*, *Drepanodus suberectus*, *Panderodus gracilis*, and *Periodon grandis*. About 96 percent of Neuville conodonts are typical of the North American midcontinent fauna and are characterized by abundance of the *Phragmodus undatus* assemblage; the remaining 4 percent, mainly *Periodon grandis* assemblage, is representative of European fauna. Late Wilderness and Barneveld faunas are recognizable, and it is possible to correlate the Neuville section with equivalent beds in Kentucky, Ohio, Indiana, Iowa, Minnesota, New York, and southern Ontario. — *from* Authors' abstract

Gluskoter, Harold J. *See* Ruch, R. R. 00601

00511 **Goldich, S. S.** Lunar and terrestrial ilmenite basalt: Science, v. 171, no. 3977, p. 1245-1246, table, 1971.

A basalt hornfels from the Keweenanwan Duluth complex in Minnesota contains 7 percent by weight of titanium dioxide and is similar in many respects to the Apollo 11 samples. Hornfels texture, as well as primary textures in lunar rocks, resemble those in Keweenawan rocks. — Author's abstract

Gooch James L. *See* Schopf, Thomas J. M. 00422

Goodwin, A. M. *See* Land, A. H. 07972

07838 **Goodwin, Bruce K.** Geology of the Hylas and Midlothian quadrangles, Virginia: Virginia Div. Mineral Resources Rept. Inv. 23, 51 p., illus., tables, geol. maps, 1970.

Here in the Piedmont just west of Richmond, Precambrian, gneisses and amphibolite are in overturned, nearly isoclinal folds; overlying them in angular unconformity are phyllitic metavolcanic rocks of lower grade, also in nearly isoclinal folds, intruded by Petersburg granite of late, Paleozoic age. Nonconformable upon this granite are Triassic sedimentary rocks along the eastern edge of Richmond basin; the basin's western boundary is a pronounced normal fault. Sources of basin sediments were both easterly and westerly. Tertiary gravels lie in angular unconformity upon eroded Triassic rocks; one of them covers upland surfaces in the Midlothian quadrangle and contains highly weathered pebbles and cobbles; another at lower elevations has

fresher pebbles and cobbles. Much crushed stone is now produced from igneous and metamorphic rocks in the area; Triassic coal has been worked; and there are some prospects for rutile. — *from* Author's abstract

00402 **Goolsby, Donald A.** Hydrogeochemical effects of injecting wastes into a limestone aquifer near Pensacola, Florida: Ground Water, v. 9, no. 1, p. 13-19, illus., table, 1971.

Acidic industrial wastes have been injected into deep wells in a limestone aquifer since 1963. Prior studies indicated that the aquifer contained nonpotable water and was overlain by a clay confining layer. Two injection wells are being used to inject waste at a rate of about 2,000 gals per minute; over three billion gallons have been injected, and waste may extend outward about one mile from the wells, and pressure effects for more than 25 miles. No wastes have been detected in a monitor well open to the Floridan aquifer, overlying the clay confining layer. In another well open to the receiving formation, geochemical effects of the waste were detected about 10 months after injection began. — *from* Author's abstract

Gottfied, David. *See* Greenland, L. Paul. 00526

07784 **Goulden, P. D.; Afghan, B. K.** An automated method for determining mercury in water: Canada Dept. Energy, Mines and Resources Inland Waters Br. Tech. Bull. 27, 21 p., illus., tables, 1970.

This report describes a method for determining the mercury content in water with mercury concentrations as low as 0.05 μg per l. The method has been applied to water samples containing both inorganic and organo-mercury compounds. It involves the oxidation of organo-mercury compounds by ultraviolet irradiation followed by the reduction of the mercury to the elemental state. The mercury is swept out of the solution by a stream of air and its concentration measured in an absorption cell in an atomic absorption spectrophotometer. For levels of mercury in the range 1.0 to 32 μg per l, the method has been automated to measure 20 samples per hour. For levels of mercury in the range 0.05 to 1.0 μg per l only 10 samples per hour can be processed because a longer sampling time is required. — Authors' summary

Grande Lopez, Fernando. *See* Grande Lopez, Raul. 07794

07794 **Grande López, Raúl; Grande López, Fernando.** Suelos fósiles del Municipio de Mexquitic de Carmona, Estado de San Luis Potosí [Fossil soils of the municipality of Mexquitic de Carmona, State of San Luis Potosi]: Geologia y Metalurgia, v. 5, no. 31, p. 51-100, illus., tables, 1970.

In the municipality of Mexquitic de Carmona, San Luis Potosí, Mexico, two soil profiles were studied, one a representative fossil soil derived from rhyolites of Pliocene to Miocene age, and the other a Pleistocene alluvial soil, formed under semi-arid conditions, which was used for comparison. Analyses of the fossil soil reveal that the degree of compaction and the presence of calcium carbonate lenses, mineralized organic remains, and kaolinite, formed from interbedded vermiculite and layered silicates with interchangeable aluminum, are evidence of its formation during the major humid periods of the Quaternary. It belongs to the order of Aridisols. Its locale on a rocky slope and its age, which is older than the last subglacial period, assign it to the Argid suborder. As it shows evidence of a major humid period and is not composed of duricrust, it is included in the Haplargids. — EH

07685 **Grant, A. C.** Recent crustal movements on the Labrador Shelf, *in* Symposium on recent crustal movements, Ottawa, Canada, 1969, Papers: Canadian Jour. Earth Sci., v. 7, no. 2, pt. 2, p. 571-575, illus., 1970.

Seismic profiler investigations have confirmed that the marginal channel that occurs on the Labrador Shelf separates crystalline Precambrian rocks underlying the inner shelf from sedimentary rocks on the outer shelf. The relief of the channel is thought to be mainly the result of glacial erosion, but there is also evidence of structural disturbance associated with this feature. Most seismic profiler transects show

pronounced upwarping of the sedimentary strata underlying the seaward side of the marginal channel. One explanation offered for this upwarping is that it may possibly be due to isostatic adjustment following removal of material by glacial erosion. — Author's abstract

07693 **Grant, Douglas R.** Recent coastal submergence of the Maritime Provinces, Canada, *in* Symposium on recent crustal movements, Ottawa, Canada, 1969, Papers: Canadian Jour. Earth Sci., v. 7, no. 2, pt. 2, p. 676-689, illus., 1970.

For the last 4000 yr the Maritime Provinces have been submerging three to five times faster than the 6 cm/century rate of eustatic sea-level rise. The Bay of Fundy shows an anomalous submergence of 24 cm/century, of which 15 cm can be accounted for by tidal changes. Submergence of the Atlantic coast of Nova Scotia exceeds the eustatic rate by 9 cm/century, explained as isostatic subsidence of the crust as the sea deepens over the shelf. Only a small part of the residual anomalies of 9 cm and 4 cm/century for the Fundy and Atlantic coasts, respectively, can be attributed to a combination of additional subsidence due to geosynclinal downwarping and relaxation of a possible glacier-margin peripheral bulge, thereby implicating other modes of regional crustal lowering. — *from* Author's abstract

07924 **Grant, Douglas Roderick.** Recent coastal submergence of the Maritime Provinces, Canada [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 31, no. 6, p. 3527B, 1970.

00409 **Grass, Luther B.; LeMert, Rose Ann.** Determination of organic and inorganic carbon on a single aliquot sample: Soil Sci. Soc. America Proc., v. 35, no. 1, p. 152-154, illus., table, 1971.

The digesting portion of the apparatus Allison described was modified to permit the determination of both organic and inorganic carbon on a single sample. The accuracy attained with the apparatus was sufficiently high to indicate that it can be used with confidence in routine analyses. The modified apparatus has several features that make it more convenient to use and that result in a saving of time and cost of analyses. — Authors' abstract

07710 **Gray, N. H.** Crystal growth and nucleation in two large diabase dikes: Canadian Jour. Earth Sci., v. 7, no. 2, pt. 1, p. 366-375, illus., tables, 1970.

The total number of nuclei, Z, of a single phase formed in a unit volume of a crystallizing magma at a distance y from the contact of a semi-infinite intrusion is: $Z = \text{constan} \cdot X\ y^n$, where n is a constant determined by growth controlling process during nucleation. The observed variation for Z for clinopyroxenes and plagioclase from the contact towards the center of two large dikes appears to follow this relation. In the 106 m wide Kigaviarluk olivine tholeiite dike the value of n is significantly greater for the clinopyroxene (-2.2) than the plagioclase (-0.84). In the 60 m Grenville dike, a quartz tholeiite, the n value (-1.5) is the same for both minerals. The growth-controlling mechanism of plagioclase and clinopyroxene appears to be sensitive to the bulk composition of the magma from which it is crystallizing. — *from* Author's abstract

Green, D. W. *See* Gillespie, J. B. 07988

00526 **Greenland, L. Paul; Tilling, Robert I.; Gottfied, David.** Distribution of cobalt between coexisting biotite and hornblende in igneous rocks: Neues Jahrb. Mineralogie Monatsh., no. 1, p. 33-62, tables, 1971.

Cobalt has been determined by neutron activation in 95 pairs of coexisting biotite and hornblende from igneous rocks ranging in composition from gabbro to syenite. The distribution ratio of Co in hornblende to Co in biotite averages 0.66 with a standard deviation of 0.13. The distribution coefficient apparently is unaffected by initial crystallization temperature, cooling history, or major element composition of the minerals or magmas. Partition of Co between biotite and hornblende appears to provide a useful estimate of the degree of equilibrium attained by a given rock system but has no potential application as a geothermometer. — Authors' abstract

Greggs, Robert G. *See* Bartlett, Grant A. 07704

Greggs, Robert G. *See* Bartlett, Grant A. 07705

Gross, G. A. *See* Land, A. H. 07972

00451 **Grove, D. B.; Beetem, W. A.** Porosity and dispersion constant calculations for a fractured carbonate aquifer using the two well tracer method: Water Resources Research, v. 7, no. 1, p. 128-134, illus., 1971.

A method described in this report uses the time concentration profile from the discharging well of a labeled recharging-discharging well pair to evaluate an aquifer's porosity and dispersion constant. The technique is applicable for pulse trace injection and recirculation. Derived equations allow prediction of streamline arc lengths and travel times between wells along streamlines. Adjacent streamlines joining the two wells define crescents that approximate dispersion columns of known length. The summation of breakthrough curve concentration profiles for flow through these individual columns provides a composite breakthrough curve for the entire flow field. Analysis of a tracer test using tritium in a fractured carbonate aquifer near Carlsbad, New Mexico, provided a dispersion constant of 125 feet and a porosity of 12.0 percent, values consistent with known properties of the aquifer. — Authors' abstract

07993 **Gumert, William R.; Cobb, Glen E.** Helicopter gravity measuring system, *in* Advances in dynamic gravimetry (Wilbur T. Kattner, editor) — Symposium, Fort Worth, Texas, 1970, Proc.: Pittsburgh, Pa., Instrument Society of America, p. 79-85, 1970.

In April 1965, the first successful measurement of gravity from a hovering helicopter was made. An efficient integrated Helicopter Gravity Measuring System (HGMS) was constructed and tested. It consists of a LaCoste and Romberg stable-platform gravimeter, a Spectra-Physics laser altimeter, a Rosemont pressure port calibrator, a 35-mm strip camera or Bendix infrared scanner, a HIRAN navigation system, a Lancer digital data logger, and necessary interface and analog recording monitors. Results of tests in an area encompassing Maryland, Virginia, and Delaware indicate that accurate gravity measurements can be made in this manner; gravity values sufficiently accurate for geodetic purposes may become routinely possible with this system. The system can be an aid in mining and petroleum exploration. — *from* Authors' abstract

00528 **Gunter, B. D.; Gleason J. D.** Isotope fractionation during gas chromatographic separations: Jour. Chromatographic Sci., v. 9 [no. 3], p. 191-192, illus., table, 1971.

Physical interaction between the sample and stationary phase during GC separations may result in severe isotopic fractionation of the effluent, making it essential to collect it totally in order to obtain quantitative results. When carbon dioxide was eluted through a Porapak column the front portions of the elution peak was enriched in C-13. When methane was eluted through molecular sieve, both the heavier species were eluted faster than the lighter ones. However, when the carbon dioxide was eluted through silica gel the first CO_2 eluted was enriched in C-13 and the last CO_2 eluted was enriched in O-18. This behavior of the isotopes probably indicates the presence of two different interaction mechanisms. — Authors' abstract

00516 **Gutschick, Raymond C.; Canis, Wayne F.** The holothurian sclerite genera *Cucumarites*, *Eocaudina*, and *Thuroholia* — Re-study of *Eocaudina* and *Protocaudina* from the Devonian of Iowa: Jour. Paleontology, v. 45, no. 2, p. 327-337, illus., table, 1971.

The genotype *Eocaudina septaforaminalis* Martin, 1952, and *Protocaudina hexagonaria* Martin, 1952, are emended and neotype specimens proposed for each. Restudy of the fauna is based on a topotype collection of more than 375 complete sclerites from the Middle Devonian Solon Member of the Cedar Valley Limestone near Urbana, Iowa. *Eocaudina* is a sieve-type sclerite with growth stages of variable shapes from subhexagonal to polygonal outline. *P. hexagonaria* is a typical protocaudinid sclerite characterized by four circular inner perforations. *Eocaudina mccor-*

macki and *Achistrum* sp. (hook sclerite) are also present in the fauna. *Cucumarites* M. DeflandreaRigaud, 1952, is invalid for sieve-type holothurian sclerites, as is *Thuroholia* Gutschick, 1954. — *from* Authors' abstract

Hacquebard, P. A. *See* Rose, E. R. 08008

07783 **Haefeli, C. J.** Regional groundwater flow between Lake Simcoe and Lake Ontario: Canada Dept. Energy, Mines and Resources Island Waters Br. Tech. Bull. 23, 42 p., illus., tables, 1970.

This paper is part of the project "Groundwater inflow into Lake Ontario," International Hydrological Decade project GW 68-3. It examines the hydrogeological conditions north of Toronto in an attempt to determine if the terrestrial water balance of the Lake Ontario basin is affected by major seepage from Lake Simcoe. The Quaternary deposits of the area are generally of low permeability with enclosed high-permeable lenses, and regional, well-defined aquifers do not exist. Results of piezometric, hydrogeochemical and mathematical analyses of the main ground-water flow systems are given. — EH

08018 **Haggerty, Stephen E.; Meyer, Henry O. A.** Apollo 12 — Opaque oxides: Earth and Planetary Sci. Letters, v. 9, no. 5, p. 379-387, illus., tables, 1970.

Electron probe analyses of eight isotropic chrome spinels and seven anisotropic chrome ulvöspinels from four unshocked microhabbros are given. Compositionally the isotropic minerals range from Usp_9Cr_{91} to $Usp_{25}Cr_{75}$, whereas the anisotropic phases range from $Usp_{74}Cr_{26}$ to $Usp_{90}Cr_{10}$ and are outside of the compositional limits of the Apollo 11 samples. Up to 4 percent by weight of Fe_2O_3 is inferred to be present in the spinels. A khaki spinel containing 90 percent ulvöspinels molecule is the richest Fe_2TiO_4 phase yet found in nature. Chrome ulvöspinels are considered to be a new series of nonisometric phases along the join Fe_2TiO_4-$FeCr_2O_4$. Based on coexisting Usp_{90} and Ilm_{100}, estimates for the temperature of crystallization do not provide a unique solution. – *from* Authors' abstract

07880 **Haines, G. V.; Hannaford, W.; Serson, P. H.** Magnetic anomaly maps of the Nordic countries and the Greenland and Norwegian Seas: Dominion Observatory Ottawa Pubs., v. 39, no. 5, illus., tables, 1970.

A three-component aeromagnetic survey of the Nordic countries and the Greenland and Norwegian Seas was carried out in the fall of 1965. The survey data were processed to yield averages over one half minute of time, or roughly 3.5 km of flight track. A regional field, in form of a third degree polynomial, was removed from the data, and the resulting '1/2-minute residuals' were plotted by computer. These residuals are represented in three ways: as residual profiles for each magnetic component; as two-dimensional vector residuals in two orthogonal planes; and as segments of contour lines. Attention is drawn to several large anomaly systems [in Greenland along west coast and central and northern geosynclines; and along Mid-Atlantic Ridge system], although no interpretation is attempted. — Authors' abstract

07830 **Hakala, W. W.** Subsidence caused by an underground nuclear explosion, *in* Symposium on engineering with nuclear explosives — Am. Nuclear Soc. and U.S. Atomic Energy Comm., Las Vegas, Nev., 1970, Proc., V. 2: Springfield, Va., Clearinghouse Federal Sci. and Tech. Inf., p. 1428-1455, illus., table, 1970.

An underground nuclear detonation creates a cavity, which may be followed by formation of a rubble chimney and possibly a surface subsidence crater. Some parameters of interest in subsidence are the height, volume, and porosity of the chimney, crater size and shape, and time required after detonation for formation of chimney or crater. The influence of properties of the subsidence medium on geometry of the crater must be considered, as well as conditions under which partial or complete subsidence is prevented. The applicability of relations developed for flow of bulk solids for small masses and low pressures to this problem is examined and comparisons are made with results observed at the Nevada Test Site. Chimney size and subsidence crater dimensions are a function of bulking characteristics of the medium, strength

parameters, dimensions of the subsurface cavity, and depth of this cavity. Prevention of subsidence is dependent on cavity size. — VSN

07752 **Halbouty, Michel T.** (editor). Geology of giant petroleum fields — Symposium, AAPG, 53d Ann. Mtg., Oklahoma City, Okla., 1968: Am. Assoc. Petroleum Geologists Mem. 14, 575 p., illus., tables, 1970.

Of the 31 papers on this theme, presented orally in April 1968, by geologists well known throughout the world, 24, many rewritten and some translated into English, are printed in this volume, along with three from other sources, the introduction, and a final summary of 266 giant fields of the world. Twelve papers deal with fields of the United States, 14 describe foreign fields, two review areas in Alberta, and one a Mexican field. Seventeen are individually cited. — GDC

07753 **Halbouty, Michel T.** Introduction, *in* Geology of giant petroleum fields — Symposium, AAPG, 53d Ann. Mtg., Oklahoma City, Okla., 1968: Am. Assoc. Petroleum Geologists Mem. 14, p. 1-7, illus., 1970.

Statistics in earlier considerations of large fields are compared with estimated reserves in the Soviet bloc nations, mainland China, and other countries. Besides meaningful geologic factors in the anatomy of a giant, engineering problems are included within the scope of many of the papers, and in the history of development of fields, the sense of technical achievement. In modes of occurrence, the unusual aspect is the key to accumulation; definition of a giant field has grown in terms of recoverable reserves; those estimated in billions of bbls of oil and over 100 Tcf of gas can be called supergiants. The final summary paper discusses reserve figures for fields of the U.S.S.R. and China. — GDC

07757 **Halbouty, Michel T.** Giant oil and gas fields in United States, *in* Geology of giant petroleum fields — Symposium, AAPG, 53d Ann. Mtg., Oklahoma City, Okla., 1968: Am. Assoc. Petroleum Geologists Mem. 14, p. 91-127, illus., tables, 1970.

Accompanying figures and two tables give data on 259 oil and 47 giant gas fields in the United States; such fields provided 50.7 percent of the 1966 production, may yield ultimately 58 percent, and are estimated to hold 57 percent of the nation's crude reserves. The rate of discovery of new giant fields appears to be declining in nearly all regions. Most major fields were discovered by deliberate exploration for structural traps; some structural tests found other subtle stratigraphic or paleogeomorphic accumulations, indicating that many more such accumulations must be present. For new reserves, greater emphasis must be placed on search for subtle traps with large accumulations, focusing exploratory thinking on geologic conditions under which such traps and accumulations form, and on purposeful and deliberate drilling of more stratigraphic and paleogeomorphic wildcat tests. — *from* Author's abstract

07768 **Halbouty, Michel T.; Meyerhoff, A. A.; King, Robert E.; Dott, Robert H., Sr.; Klemme, H. Douglas; Shabad, Theodore.** World's giant oil and gas fields, geologic factors affecting their formation, and basin classification — 2 Pts., *in* Geology of giant petroleum fields — Symposium, AAPG, 53d Ann. Mtg., Oklahoma City, Okla., 968: Am. Assoc. Petroleum Geologists Mem. 14, p. 502-555, illus., tables, 1970.

Defined here as having estimated ultimate reserves of at least 500 million bbl of oil or 3.5 trillion cu ft of gas each, are 266 giant fields of the world; 58 percent are in a wide arcuate band extending from Algeria through China to the Arctic Ocean off Ural Mts. Part 1 lists 187 oil and 79 gas fields in decreasing order of reserves, with selected geologic and reservoir parameters, and cumulative production. Of all reserves, 62 percent are in sandstone, 38 percent in carbonate reservoirs; Tertiary rocks hold 24 percent, Mesozoic 63 percent, Paleozoic 13 percent. Part 2 analyzes characteristics of fields, discusses factors in their formation, relates occurrence to sedimentary basins of different types; only 25 are stratigraphic traps, 78 unconformity related. The preponderance of 237 anticlinal fields reflects exploration aimed at structure; future giants will be found offshore. — GDC

Haley, James F. *See* Comm. on Subsoils of Boston. 07865

07874 **Hall, Bradford A.** Stratigraphy of the southern end of the Munsungun anticlinorium, Maine: Maine Geol. Survey Bull. 22, 63 p., illus., table, geol. map, 1970.

The map area, about 25 mi north of Mt. Katahdin, Maine, straddles the southern end of the Munsungun anticlinorium, a northern, disconnected extension of the Boundary Mtn. anticlinorium of New Hampshire. Some 36,000 feet of Cambrian (?) through Lower Devonian rocks are differentiated into 10 formations (nine new, named herein): 1 Cambrian, 4 Middle Ordovician, 4 Late Silurian-Early Devonian, 1 Early Devonian. The most fossiliferous, slightly metamorphosed, highly volcanic Middle Ordovician section in the northern Appalachians is present in the area. Effects of an early deformation (Cambrian ?), and of the Taconian and Acadian orogenies are discussed. Two sets of faults are present – northeast-striking and later northwest-striking faults, both of post-Early Devonian age. Appendix I gives the location and description of fossil collections from the area. – VSN

Haller, W. A. *See* Shah, K. R. 07850

00476 **Hamelin, Louis-Edmond.** De Winnipeg au Keewatin — L'excursion de l'A.C.G. [From Winnipeg to Keewatin — Excursion of the Canadian Association of Geographers]: Rev. Géographie Montréal, v. 25, no. 1, p. 89-94, illus., 1971.

After commenting briefly on the eight-day excursion of June 1970, which emphasized principal aspects of economic and cultural geography of the Manitoban northland, Hamelin presents supplementary notes on cold climate features of the region and glaciology of Hudson Bay. Organic terrain features are dominant between Gillam and Churchill; palsen (large earth hummocks covered by peat) and string bogs of linear, concentric, braided, and other drainage patterns are the most common forms; other features are beaded streams, thermokarst ponds, and cuspated river banks. North of Churchill, permafrost features are developed on the mineral surface with little or no vegetal cover; these include ice-wedge polygons, thufurs, thermokarst depressions of many forms, glacial boulder fields, and gelifluction flows. The term "prairie" is considered inappropriate for this region. — VMJ

Hanan, Robert V. *See* Stewart, Joseph W. 07900

Hannaford, W. *See* Haines, G. V. 07880

00401 **Hansen, Harry J.** Common stratigraphic boundaries associated with Coastal Plain aquifers: Ground Water, v. 9, no. 1, p. 5-12, illus., 1971.

There is a tendency during the verification stage of aquifer model building to manipulate stratigraphic boundaries. This procedure is acceptable insofar as the geohydrologist is sufficiently knowledgeable to sense the point at which the manipulations encroach upon the integrity of his model. Examples from the Maryland Coastal Plain are used to depict several types of stratigraphic boundaries. These include erosional truncation, overlap (or pinchout), disconformity, and facies change. Defining statements are given for each in order to clarify the stratigraphic implications of boundary modeling. — Author's abstract

00489 **Hanson, G. N.** Radiogenic argon loss from biotites in whole rock heating experiments: Geochim. et Cosmochim. Acta, v. 35, no. 1, p. 101-107, illus., table, 1971.

Upon heating in nitrogen, both the radiogenic argon content and d_{001} for biotite decrease and reach a constant value within 10 days. Biotites from heated whole rocks lose less argon than heated biotite separates, although they have the same decrease in d_{001}. Biotites from whole rocks heated in air have a greater decrease in d_{001} and less loss of argon than those heated in nitrogen. — Author's abstract

00562 **Hardy, Rolland L.** Multiquadric equations of topography and other irregular surfaces: Jour. Geophys. Research, v. 76, no. 8, p. 1905-1915, illus., 1971.

A new analytical method of representing irregular surfaces that involves the summation of equations of quadric surfaces having unknown coefficients is described. The quadric surfaces are located at significant points throughout the region to be

mapped. Procedures are given for solving multiquadric equations of topography that are based on coordinate data. Contoured multiquadric surfaces are compared with topography and other irregular surfaces from which the multiquadric equation was derived. — Author's abstract

07736 **Harnett, Richard A.** How to operate an oilfield — An outline for the inexperienced: Earth Sci. Bull., v. 3, no. 4, p. 13-18, illus., 1970.

The geologist who somehow comes across a chance to get into oilfield producing operations should have legal and experienced operating advice before starting. Once into the operations, he personally must acquire the skills and tools to keep the oil coming. Each decision has a very real dollar sign attached, with profit as the motive. — Author's abstract

Harris, John E. *See* Pequegnat, Willis E. 00437

00430 **Harris, John M.** Chemical preparation of gypsum encrusted vertebrate material: Jour. Paleontology, v. 45, no. 2, p. 350, 1971.

Standard procedures for acid preparation are inapplicable to gypsum encrusted specimens, because gypsum is not readily soluble in acetic or formic acid. Ammonium chloride in dilute solution (10-20 percent) dissolves gypsum without detriment to bone or tooth material. — FCW

Harris, L. D. *See* Mixon, R. B. 00455

Harrison, C. G. A. *See* Akker, F. B. van den. 07801

00508 **Harrison, W.** Prediction of beach changes, *in* Progress in geography — International reviews of current research, V. 2: New York, St. Martin's Press (also London, Edward Arnold Ltd., 1970), p. 207-235, illus., tables, 1971; originally published as "Empirical equations for foreshore changes over a tidal cycle," 1969.

The original paper was published in *Marine Geology*, v. 7, no. 6, p. 529-555, 1969 (*see* Abs. North American Geology, June 1970). It is reprinted here with minor modifications. — GDC

07877 **Hartman, Charles W.; Carlson, Robert F.** Bibliography of arctic water resources: Alaska Univ. Inst. Water Resources Rept. IWR-11, 344 p., 1970.

This study provides a literature review on land-based water resources of the Arctic with emphasis on Alaska's arctic and subarctic areas. The keyword format is used as well as an alphabetical listing of 2,978 references. — EH

Harvey, E. J. *See* Gann, E. E. 00535

Haskin, L. A. *See* Allen, R. O. 07907

Haskin, Larry A. *See* Frey, Frederick A. 00551

Haskin, Mary A. *See* Frey, Frederick A. 00551

07844 **Hassan, Farkhonda.** Anisotropic color centers related to iron in amethyst quartz [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 31, no. 5, p. 2763B, 1970.

Hathout, S. A. *See* Bunting, B. T. 07959

Haun, John D. *See* Barlow, James A., Jr. 07759

Hawke, B. Ray. *See* Kepferle, Roy C. 00461

08046 **Haynes, C. Vance.** Geochronology of man-mammoth sites and their bearing on the origin of the Llano Complex, *in* Pleistocene and recent environments of the central Great Plains: Kansas Univ. Dept. Geology Spec. Pub. 3, p. 77-92, illus., table, 1970.

Remarkable parallels exist between campsites of mammoth hunters in the Old and New Worlds during the late glacial period. It is unlikely that Clovis artifact progenitors migrated from Siberia to central North America before the Late Wisconsin glacial stages because of shortness of time between emergence of Bering land bridge and blocking of Canada by glacial ice. The Clovis 'population explosion' of 11,000 to 12,000 yr ago is best explained by a Late Wisconsin migration of hunters out of Alaska as soon as passage through Canada became possible during the Two Creeks glacial retreat of 12,000 to 13,000 yr ago. — *from* Author's abstract

07833 **Heard, Hugh C.** The influence of environment on the inelastic behavior of rocks, *in* Symposium on engineering with nuclear explosives — Am. Nuclear Soc. and U.S. Atomic Energy Comm., Las Vegas, Nev., 1970, Proc., V. 1: Springfield, Va., Clearinghouse Federal Sci. and Tech. Inf., p. 127-141, illus., 1970.

Quantative data illustrating the effect of the deformation environment [mean pressure, pore fluid pressure, temperature, strain rate, magnitude of intermediate principal stress compared to maximum and minimum stresses] upon the strength and brittle-ductile behavior are presented for a suite of rocks of interest to the Plowshare program; among these rocks are limestone, quartzite, granite, sandstone and 'oil-shale.' More limited results are presented illustrating the effect of planar anisotropies, and of grain size upon mechanical properties. Available data may be used to infer the mechanical response of rocks at extreme conditions near a nuclear detonation. — *from* Author's abstract

07809 **Helmstaedt, H.** Geology of map area O-6, Head of Middle River and Wildcat Brook (northern New Brunswick): New Brunswick Dept. Nat. Resources Mineral Resources Br. Map Ser. 70-1, 18 p., illus., table, geol. map, 1970.

For structural analysis of the Ordovician Folded Belt, a test was made as to whether mapping of mesoscopic fabric elements can provide additional information in areas of scarce outcrop and incomplete stratigraphy; encouraging findings are outlined. The map area, in Central Highlands, is well covered by Pleistocene sediments. Earlier investigators detailed stratigraphy and structure of the Tetagouche Group as a whole and petrography of the acid volcanic rocks; relative age interpretations are not yet proven. In the O-6 map area, rocks of igneous origin predominate, their primary textures obliterated by low-grade metamorphism and at least three phases of deformation. Most of the area is on part of the N-S limb of a prominant regional fold whose axial trend is northeast; only the northwest corner is on the E-W limb. Many of the small mafic intrusions, seemingly fresh and little deformed, are related to Silurian or Devonian volcanism. — GDC

Helmstaedt, H. *See* Brown, R. L. 08055

07756 **Hemphill, C. R.; Smith, R. I.; Szabo, F.** Geology of Beaverhill Lake reefs, Swan Hills area, Alberta, *in* Geology of giant petroleum fields — Symposium, AAPG, 53d Ann. Mtg., Oklahoma City, Okla., 1968: Am. Assoc. Petroleum Geologists Mem. 14, p. 50-90, illus., tables, 1970.

With in-place reserves of 5.9 billion bbl of oil and 4.5 trillion cu ft of gas, Devonian strata, in the southeast on an eroded Cambrian section, lap in the northwest onto Precambrian granite of Peace River arch. Upper Elk Point and Beaverhill Lake sedimentation was in an embayment conducive to reef development in the central Swan Hills region. Carbonate-bank deposition, flanking the Western Alberta ridge, persisted through Beaverhill Lake time and merged with the overlying Woodbend reef system. Swan Hills Formation, the 300-ft-thick reef and +400-ft-thick carbonate-bank facies of Beaverhill Lake Group, is considered equivalent in age to the Calmut and younger members of Waterways Formation, an offreef shale and limestone facies. Six major stages of development are postulated in the undolomitized producing reef in Swan Hills field. Stromatoporoids are the dominant reef-builders; *Amphipora* are abundant in restricted lagoonal facies. — GDC

07770 **Hemphill, William R.** Geologic applications program — Summary of recent progress and plans, *in* Earth Resources Aircraft Program, status review, V. 1: Houston, Tex., U.S. Natl. Aeronautics and Space Admin., Manned Spacecraft Center, p. 1-1—1-4, [1970,].

Studies conducted in 1969 under this program for evaluating application of airborne and satellite-borne remote-sensing systems to discrimination and identification of geologic materials, included the following: airborne multiband line-scan imagery of Yellowstone National Park; studies along the Atlantic and Gulf coasts to observe dynamics of sediment movement and rates of deposition and erosion of shore areas; relating near infrared spectral reflectance of balsam fir and red spruce on Catheart Mountain, Maine, test site to geochemical anomalies in soil; analysis of aerial photographs on scales smaller than 1:120,000 for geologic information; analysis of radar mosaic of Massachusetts for geologic relations; beginning of program at Mill Creek, Okla., to test remote sensors at sites of well exposed simple mineralogy; compilation of soils associate map from Gemini and Apollo photos; and other programs. Work for FY70 is outlined. — VSN

00503 **Henderson, G. V.** The origin of pyrophyllite-rectorite in shales of north central Utah [with French, German, Russian abs.]: Utah Geol. and Mineralog. Survey Spec. Studies 34, 46 p., illus., tables, 1971.

This is a more detailed version of the paper published *in* Clays and Clay Minerals, v. 18, no. 5, p. 239-246, 1970; *see* Abs. North American Geology, August 1971.

07853 **Henderson, J. H.; Syers, J. K.; Jackson, M. L.** Quartz dissolution as influenced by pH and the presence of a disturbed surface layer: Israel Jour. Chemistry, v. 8, no. 3, p. 357-372, illus., tables, 1970.

Grinding of quartz particles in the labroatory produces a disturbed surface layer which has dissolution properties intermediate between those of amorphous silica and crystalline quartz. This layer can effectively be removed by chemical treatment for dissolution studies of crystalline "clean" quartz. The SiO_2 dissolution from chemically "cleaned" quartz and from control samples washed five times with H_2O was found to be pH dependent over the range of pH 4 to 10 in buffer solutions having a constant Na^+ concentration. Quartz particles treated with 1*N* HF to remove the disturbed surface layer adsorbed SiO_2 from buffer solutions supersaturated in SiO_2, with respect to the "cleaned" quartz in both acid and alkaline suspensions. — *from* Authors' conclusions

Henderson, William T. *See* Hildreth, Robert A. 00573

00543 **Henoch, W. E. S.** Estimate of glaciers secular (1948-1966) volumetric change and its contribution to the discharge in the Upper North Saskatchewan River Basin: Jour. Hydrology, v. 12, no. 2, p. 145-160, illus., tables, 1971.

The recent trend of glacier recession in the Rocky Mountains began in the late 19th century. Since that time numerous studies of glaciers have been made, but estimates of glacier volume decrease and the resultant increase in river discharge are lacking. Quantitative measurements show that glacier volume loss in the Upper North Saskatchewan River Basin during the period 1948-1966 was $1000 \times 10^6 m^3$. This is approximately 4 percent of the total discharge determined from the records of the hydrometric stations at Saskatchewan Crossing and Mistaya River. — Author's abstract

00569 **Herzog, G. F.; Anders, Edward.** Radiation age of the Norton County meteorite: Geochim. et Cosmochim. Acta, v. 35, no. 2, p. 239-244, tables, 1971.

The radiation age of the Norton County aubrite has been redetermined as 107 m.y. by the Ne-21/Al-26 method — much shorter than the earlier values of 220 m.y. and 500 m.y. obtained by the He-3/H-3 and Ar-38/Ar-39 methods. The new value no longer contradicts the notion that radiation ages of stony meteorites are governed by their lifetimes against collisional fragmentation. — Authors' abstract

00378 **Hewett, D. F.** Coronadite — Modes of occurrence and origin: Econ. Geology, v. 66, no. 1, Bateman issue, p. 164-177, illus., tables, 1971.

Coronadite has been identified at 22 localities in New Mexico, Arizona, Nevada, and California, as well as in U.S.S.R., Morocco, England, Australia, and India. Review of

occurrences and interpretation of environments "show that the mineral is found in veins and hot-spring aprons, where it seems to have been deposited by hydrothermal waters from depth, and that it is one of the manganese oxide minerals deposited as sediments. Probably it is more widely found in assemblages of minerals of supergene origin." — *from* Author's abstract

07925 **Hewitt, David Allyn.** An experimental and field investigation of the progressive metamorphism of micaceous limestones [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 31, no. 6, p. 3480B-3481B, 1970.

Heymann, Dieter. *See* Taylor, G. Jeffrey. 00563

Heymann, Dieter. *See* Taylor, G. Jeffrey. 00598

07873 **Hibbard, Claude W.** The Pliocene rodent *Microtoscoptes disjunctus* (Wilson) from Idaho and Wyoming: Michigan Univ. Mus. Paleontology Contr., v. 23, no. 6, p. 95-98, illus., 1970.

The rare rodent *Microtoscoptes disjunctus* (Wilson) 1937, tentatively considered an aberrant arvicoline cricetid, is known from Hemphillian (middle Pliocene) deposits at two localities in eastern Oregon, one in Idaho, and one in Wyoming. Here described and figured are a lower jaw with M_1 and M_2, a delayed report from Gooding County, Idaho; and the first known skull element, a fragmentary maxillary with M^1 and M^2, an addition to previously reported material from Teton County, Wyo. Occlusal lengths of teeth are given. Specimens at all localities have been found associated with remains of beavers, suggesting a marsh habitat. — VMJ

08053 **Hibbard, Claude W.** Pleistocene mammalian local faunas from the Great Plains and central lowland provinces of the United States, *in* Pleistocene and recent environments of the central Great Plains: Kansas Univ. Dept. Geology Spec. Pub. 3, p. 395-433, illus., tables, 1970.

The Pleistocene mammalian faunal sequence of the physiographic divisions of Texas, New Mexico, Oklahoma, Kansas, and Nebraska is listed and a bibliography is given for each fauna or biota. The 37 faunas treated have been recovered south of the nonglaciated region and are tentatively correlated with events in the glaciated region. Taxa are assigned to each glacial or interglacial interval of time, first and last appearance are given, geographic shifts of distribution are noted, taxa formerly sympatric but now allopatric are discussed on the basis of climate at the time they were together, and an interpretation of environment as suggested by mammals and the entire biota is given. — *from* Author's abstract

07792 **Higgins, A. K.** The stratigraphy and structure of the Ketilidian rocks of Midternaes, South-West Greenland: Grönlands Geol. Undersögelse Bull., no. 87, 96 p., illus., tables, geol. maps, 1970.

The stratigraphy and deforming structures of the Ketilidian rocks of the Midternaes area are described. Correlations between the Midternaes area and the Ketilidian type area of Graenseland, immediately to the south, are made on group and formation level; the Vallen and Sortis Group and their respective formations are recognized. Total thickness of exposed Ketilidian strata is about 5000 m; the Vallen Group is mainly sedimentary and the Sortis Group comprises thick sequences of pillow lavas of tholeiitic basalt intruded by gabbroic sills. Large-scale warping of the sub-Ketilidian surface may have preceded mesoscopic folding. Kink and conjugate folds in Ketilidian and pre-Ketilidian rocks seem to have occurred under stress conditions comparable to those producing faults; principal faults are tear faults. Chronology of dikes is discussed briefly; the major swarm is probably of Gardar age. — *from* Author's abstract

00564 **Higgins, G.; Kennedy, G. C.** The adiabatic gradient and the melting point gradient in the core of the Earth: Jour. Geophys. Research, v. 76, no. 8, p. 1870-1878, illus., table, 1971.

The melting gradient and the adiabatic gradient throughout the core of the Earth are compared. The temperature of melting of iron at pressures equivalent to the inner core-outer core boundary is estimated to be about 4250°C with a melting point gradient of approximately 500°C through the outer core. The adiabatic gradient through the outer core is estimated to be about 1250°; therefore, for the outer core to be liquid, its temperature must be considerably above the temperature in adiabatic equilibrium with the inner-outer core boundary. The temperature distribution throughout the outer core is deduced to follow a melting point curve. This temperature distribution should provide a substantial inhibition to radial components of convection in the outer core. — Authors' abstract

00573 **Hildreth, Robert A.; Henderson, William T.** Comparison of Sr-87/Sr-86 for seawater strontium and the Eimer and Amend $SrCO_3$: Geochim. et Cosmochim. Acta, v. 35, no. 2, p. 235-238, tables, 1971.

A series of analyses were undertaken to determine a precise difference between seawater strontium and the Eimer and Amend $SrCO_3$ standard. A mean difference between the sea-water composite and the Eimer and Amend $SrCO_3$ of $0.00107 \pm 0.00004_2$ was obtained. — Authors' abstract

Hillman, Norman S. *See* Saito, Tsunemasa. 07787

00520 **Hiltabrand, R. R.** Montmorillonite-organic complexes — Bonding energies associated with ion extraction: Modern Geology, v. 2, no. 1, p. 49-54, illus., 1971.

The degree of bonding that clay surfaces have with respect to water and different organic solvents and the effect that these solvents have on removing absorbed water and cations from a clay mineral is determined and compared. Organic liquids used were chosen for dehydrating properties and high miscibility in water. The $< 2\mu$ fractions of five different montmorillonite clays were dried at constant humidity for one week and then independently saturated with equal amounts of ethanol, dimethyl formamide, ethylene glycol, and water. A 10-mg sample of each was subjected to differential thermal analysis to determine bonding strength between clay surface and solvent. Exchangeable ions were extracted from one gram samples of the $< 2\mu$ fraction of each clay with 50 ml water, ethanol, dimethyl formamide, and ethylene glycol. The liquid was removed by centrifugation, and the concentration of Ca, Mg, and Na in the solvent determined by atomic absorption. — *from* Author's abstract

00592 **Hirasawa, Tomowo; Berry, Michael J.** Reflected and head waves from a linear transition layer in a fluid medium: Seismol. Soc. America Bull., v. 61, no. 1, p. 1-25, illus., 1971.

Reflected and head waves from a linear transition layer between two homogeneous mediums are studied in the frequency domain, for the case of a point source in the upper fluid of lower velocity, with velocity structure continuous throughout. Exact solutions derived by numerical evaluation of the contour integrals in the complex wave-number plane are compared with approximate solutions obtained by the saddle point method. For head and reflected waves beyond the critical distance, the approximate solutions are asymptotic for large values of r/2h; for reflected waves inside the critical distance they are asymptotic for large values of H/2h (H = sum of vertical distance of source and a receiver from transition layer of thickness 2h, r = horizontal distance of receiver from source). Contributions from complex poles are significant near the critical distance if the transition layer is thick. — DBV

Hoagland, G. W. *See* Borchardt, G. A. 07851

Hoffer, Roger M. *See* Smedes, Harry W. 07772

08052 **Hoffmann, Robert S.; Jones, J. Knox, Jr.** Influence of late-glacial and post-glacial events on the distribution of recent mammals on the northern Great Plains, *in* Pleistocene and recent environments of the central Great Plains: Kansas Univ. Dept. Geology Spec. Pub. 3, p. 355-394, illus., tables, 1970.

Existence of true grassland and steppe mammal species, with relatively narrow habitat requirements and largely concordant patterns of distribution, argues for continuous existence of a true steppe or savannah environment on the Great Plains throughout late Pleistocene, albeit shifting in location. Southwestern steep and desert mammals may have spread northward in post-Wisconsin time during drier periods; some Sonoran or Neotropical species may be moving northward presently in response to a recent continental warming trend. Steppe and desert mammals of the Great Basin pushed eastward on the plains in interglacial and post-Wisconsin period through low passes in Montana and Wyoming. Discontinuous ranges of certain mammals reflect the presently discontinuous distribution of both coniferous and deciduous forest in the northern Great Plains. — *from* Authors' abstract

Holdridge, D. A. *See* Davis, C. E. 07869

07926 **Holloway, John Requa.** Phase relations and compositions in the basalt-CO_2-H_2O system at high temperatures and pressures [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 31, no. 6, p. 3590B, 1970.

07750 **Hollyday, Este F.** Use of infrared radiometry in measuring ground-water inflow to streams, Delmarva Peninsula, Maryland and Delaware, *in* Earth Resources Aircraft Program, status review, 2d Ann., Houston, Tex., 1969 — V. 3, Hydrology and oceanography: Houston, Tex., U.S. Natl. Aeronautics and Space Admin., Manned Spacecraft Center, p. 44-1—44-14, illus., [1970,].

A convective heat budget is used to calculate ground-water inflow to small alluvial streams. Stream temperatures are measured radiometrically from aircraft flying along a stream; upstream discharge and ground-water inflow temperature are measured by a ground team. Ground-water inflow and downstream discharge may be calculated for any desired subreach within the reach flown. Time required for data collection may be greatly reduced as compared with time required to make a seepage run. Inflow to a reach of Beaverdam Creek near Milton, Delaware, is calculated to be 5.7 cu ft per sec, which agrees within 11 percent with inflow determined by standard stream-gaging techniques. Downstream discharge is calculated to be 9.1 cu ft per sec, which agrees within 7.5 percent. — Author's abstract

00389 **Holmes, Stanley W.** Massive sulfide environment — Volcanic-sedimentary basins [abs]: Econ. Geology, v. 66, no. 1, p. 207, 1971.

08082 **Holter, M. R.** September 1969 annual report of NASA supported remote sensing activities at the University of Michigan Willow Run Laboratories, *in* Earth Resources Aircraft Program, status review, 2d Ann., Houston, Tex., 1969 — V. 2, Agriculture, Forestry, and sensor studies: Houston, Tex., U.S. Natl. Aeronautics and Space Admin., Manned Spacecraft Center, p. 27-1—27-36, illus., tables, [1970,].

This report discusses work at the University of Michigan Willow Run Laboratories on data processing, interpretation, and utilization of remote-sensing test surveys in 1969. Illustrative examples are cited. — VSN

Homuth, E. Fred. *See* Boucher, Gary. 00467

Hood, Donald W. *See* Slowey, J. Frank. 00565

Hopkins, William S., Jr. *See* King, Lewis H. 07674

00530 **Howard, Alan D.** Simulation of stream networks by headward growth and branching: Geog. Analysis, v. 3, no. 1, p. 29-50, illus., tables, 1971.

Headward growth and branching are probably reasonable approximations to development of certain natural stream systems. Models are discussed in this paper that result in networks which simulate statistical properties of natural stream systems and also model formation of the stream network in real time. Two types of growth models are discussed: Model 1, growth of a stream network by successive generations in each of which every active stream may continue unchanged, branch, or terminate;

which event occurs is resolved by comparison of random numbers with the probability parameters of the model. Model 2, the condition of restricting events during each generation to one matrix location is simulated by continued random selection of stream heads with determination of growth, inactivity, or continuation at that location. — VSN

Huber, Richie D. *See* Adams, William M. 00404

07896 **Hughes, J. E.** Structural geology, Pine River area of the Rocky Mountain Foothills, *in* Peace River, Pine Pass, Yellowhead 1970 — Edmonton Geol. Soc. Field Conf., 12th, Guidebook: Edmonton, Alberta, Edmonton Geological Society, p. 39-45, illus., 1970.

The Foothills in this area are 37 mi wide and expose Triassic to Late Cretaceous strata. The scale of deformation increases from east to west, with older strata uplifted westwards. The Foothills can be divided into the Outer (Eastern) and Inner (Western) Foothills. These divisions represent different styles of Laramide tectonism, which are reflected in landforms. Structures of the Inner and Outer Foothills are distinct; those of the Outer Foothills can be ascribed to faulting and displacements of the basement; while those of the Inner, indicate major lateral compression and uplift and dislocation of the sedimentary cover, and belong to the orogenic zone. Major thrusts with displacements of more than 3,000 feet mark their boundary with the Rocky Mts. — ESL

07683 **Hughes, O. L.** Incidental observations on Quaternary crustal movements, central Yukon Territory — [Discussion of "Volcanism and its relationship to recent crustal movements in the Canadian Cordillera," by J. G. Souther, 1970], *in* Symposium on recent crustal movements, Ottawa, Canada, 1969, Papers: Canadian Jour. Earth Sci., v. 7, no. 2, pt. 2, p. 569, 1970.

For original paper, *see* ibid., p. 553-568.

00439 **Hughes, Richard David.** Alexander Murray (1910-1884), *in* History of Canadian Geologists: Geol. Assoc. Canada Proc., v. 23, p. 1-4, portrait, 1971.

Hulston, J. R. *See* Thode, H. G. 00487

08075 **Hunn, J. D.; Cherry, R. N.** Remote sensing of offshore springs and spring discharge along the Gulf Coast of central Florida, *in* Earth Resources Aircraft Program, status review, 2d Ann., Houston, Tex., 1969 — V. 3, Hydrology and oceanography: Houston, Tex., U.S. Natl. Aeronautics and Space Admin., Manned Spacecraft Center, p. 39-1—39-7, illus., [1970,].

Color, infrared, and multiband black and white photography were used as sensors to detect submerged sinkholes in the Gulf of Mexico off the coast of central Florida where direct discharge of ground water from the Floridan aquifer is possible. All known offshore springs and four sinkholes in the Gulf not previously known were identified on aerial photographs. Color photography (Ektachrome 8442, no filter) proved the most useful sensor; color infrared was equally satisfactory in very shallow water. Detection of offshore discharge can be used in construction of water-level contour maps and to predict areas where channel dredging into rock might cause increased submerged discharge of fresh water into the sea. — VSN

00408 **Hunsaker, V. E.; Pratt, P. F.** Calcium magnesium exchange equilibria in soils: Soil Sci. Soc. America Proc., v. 35, no. 1, p. 151-152, illus., table, 1971.

Exchange equilibria measurements showed that a hydroxy-Al coated montmorillonite clay had a higher preference for Ca than the original clay. Allophane, an organic soil, and soils which contain amorphous minerals or kaolinite plus gibbsite all showed higher preference for Ca than is expected in montmorillonitic clays and soils. — Soil brief

07820 **Hunt, G. H.** Geology of the Iskwasum Lake area (west half), The Pas mining district, Manitoba: Manitoba Dept. Mines and Nat. Resources Mines Br. Pub. 65-3, 40 p., illus., tables, geol. map, 1970.

The map area lies within the Flin Flon-Snow Lake volcanic sedimentary belt in the Churchill structural province. Dolomite escarpments rise 50 feet above Leak Lake and bedrock is exposed on hills and ridges. Pleistocene glaciation left a thin covering of glacial deposits over much of the area, also lakes, striae, and roches moutonnees. The Wekusko Group consists of interlayered Archean lava flows, pyroclastics, metasediments, and serpentinite intrusions. Granodiorite, "quartz-eye" granite, tonalite, and adamellite comprise plutons intruding this group. The southern part of the area is underlain by thin-bedded, flat-lying Ordovician limestones and dolomites. The Precambrian fault and fold pattern trends north and northeast. Plutonic-volcanic contacts are a controlling factor, but some major faults cut across plutons. There are 60 gold prospects and three former mines in the area, chiefly in "quartz-eye" granite. — EH

00412 **Hunt, Graham R.; Salisbury, John W.** Visible and near-infrared spectra of minerals and rocks — [Pt.] 2, Carbonates: Modern Geology, v. 2, no. 1, p. 23-30, illus., tables, 1971.

Visible and near-infrared spectra of various carbonate minerals are presented, together with explanations of spectral features. It is shown that the principal bands are due to electronic processes in the cation or impurity ions, or to vibrational processes in the carbonate radical as an entity, or to interactions of it with the motions of the crystal lattice. Typically, the most prominent bands are overtone or combination tones of the carbonate radical. Of the cations, iron is the most common source of electronic features, either as the principal constituent or as an impurity. Other features are produced by copper and manganese ions. — Authors' abstract

08033 **Hunter, Garry T.** Postglacial uplift at Fort Albany, James Bay: Canadian Jour. Earth Sci., v. 7, no. 2, pt. 1, p. 547-548, 1970.

Support for the postglacial uplift estimates for the Cape Henrietta Maria region, as presented by Webber, *et al.*, this volume, p. 317-325, 1970, is offered. — HRC

Hurley, P. M. *See* Fairbairn, H. W. 00567

Hussong, Donald M. *See* Furumoto, Augustine S. 00471

07744 **Hutchison, W. W.** Metamorphic framework and plutonic styles in the Prince Rupert region of the central Coast Mountains, British Columbia: Canadian Jour. Earth Sci., v. 7, no. 2, pt. 1, p. 376-405, illus., tables, 1970.

The metamorphic framework of this area comprises schist, gneiss, and migmatite displaying retrogressive regional metamorphism. The belt is apparently not paired. Plutonic rocks, part of the metamorphic framework, were mobilized during metamorphism and continued to move out of the original environment while metamorphism waned. Four styles have been recognized: autochthonous, migmatitic, plutonic complexes; para-autochthonous, steep-walled (tadpole) plutons; para-autochthonous, tongue-shaped, recumbent plutons; and allochthonous, intrusive plutons. During movement, the rocks became more homogeneous, less migmatitic and impoverished in inclusions, less foliated, more acidic, more biotite-rich, more abundant in plagioclase of lower anorthite, and with more complexly zoned crystals. The time of emplacement is not known. — *from* Author's abstract

Imrie, Alan S. *See* Jory, Lisle T. 07894

Ingle, James C., Jr. *See* Bandy, Orville L. 00496

Innes, D. G. *See* Bennett, G. 00438

07702 **Irving, E.; Robertson, W. A.; Aumento, F.** The Mid-Atlantic Ridge near 45° N. — [Pt.] 6, Remanent intensity, susceptibility, and iron content of dredged samples: Canadian Jour. Earth Sci., v. 7, no. 2, pt. 1, p. 226-238, illus., tables, 1970.

Seventy-five samples from 150 km west to 70 km east of the Median Valley of the Mid-Atlantic Ridge at 45° N. are mostly basalt with a mean remanent intensity of 92 $\times 10^{-4}$ and a mean susceptibility of 0.9×10^{-4} cgs cm^{-3}. Remanence decreases with distance from the axis. Other properties also vary with distance; the blocking temperatures and stability increase, and the ratio FeO/Fe_2O_3 decreases with distance. Nonbasaltic rocks include serpentinized peridotite, greenstone, gabbro, and diabase. The peridotite samples are strongly magnetic with a mean intensity of 23×10^{-4} cgs cm^{-3}. Greenstones, gabbros, and diabase are weakly magnetized, with mean intensities of about 10^{-4}. Basalt showing partial alteration to greenstone has an intermediate intensity, showing demagnetization by such a metamorphic process. The remanence and susceptibility of 18 "erratic" samples, thought from other evidence to have been deposited by Pleistocene icebergs, have a wide and irregular spread. — *from* Authors' abstract

Ives, William, Jr. *See* Bayne, Charles K. 00583

Jackson, M. L. *See* Henderson, J. H. 07853

Jackson, R. H. *See* Bunting, B. T. 07957

Jackson, T. L. *See* Westermann, D. T. 00405

07968 **Jacobs, J. A.** The Earth's core: Comments Earth Sci. — Geophysics, v. 1, no. 2, p. 36-42, 1970.

Theories of accretion of the Earth and core formation, and the development of physical properties, the age, and evidence of fluidity of the core are reviewed. — VSN

00390 **Jacoby, Charles H.** Evaluation of salt deposits [abs]: Econ. Geology, v. 66, no. 1, p. 207, 1971.

00549 **James, David E.** Anomalous Love wave phase velocities: Jour. Geophys. Research, v. 76, no. 8, p. 2077-2083, illus., table, 1971.

Anomalously high Love wave phase velocities in the period range 60-110 sec have been measured between the station pair La Paz, Bolivia (LPB), and Arequipa, Peru (ARE) for an earthquake in the Congo Republic. The implied upper mantle anisotropy necessary to produce agreement between Love and Rayleigh wave phase velocities is of the order of 15 percent. Examination of the LPB and ARE G1 seismograms shows clearly that the first and possibly also the second higher Love modes have been excited and that the first higher mode may be traveling with nearly the same group velocity as the fundamental mode at periods greater than 60 sec. G3 phase velocities for the same earthquake, measured in the period range 60-110 sec. exhibit 'normal' behavior. The normal G3 phase velocities, together with the clear indication of higher mode contamination of the G1 wave train, provide unambiguous evidence that in this instance anomalous Love wave phase velocities result from higher mode interference. — *from* Author's abstract

07927 **James, Gerard W.** Stratigraphic geochemistry of a Pennsylvanian black shale (Excello) in the mid-continent and Illinois basin [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 31, no. 6, p. 3481B, 1970.

00381 **James, Harold L.** Alan Mara Bateman — An appreciation: Econ. Geology, v. 66, no. 1, Bateman issue, p. 202, 1971.

Janal, Martin J. *See* Saito, Tsunemasa. 07787

Jauffred, Jean-Claude. *See* Globensky, Yvon. 00446

07795 **Jáuregui Ostos, Ernesto.** La erosión hidráulica y eólica en México y sus efectos en las estructuras hidráulicas y en los núcleos de población [Hydraulic and eolian erosion in Mexico and its effect on hydraulic structures and on population centers]: México Univ. Nac. Autónoma Inst. Geografía Bol., v. 3, p. 39-60, illus., tables, 1970.

Evaporation, precipitation and infiltration stages of a hydrologic cycle are described as well as the erosive action of surface runoff on soils and the effects of sediments on hydraulic structures. Wind erosion in semi-arid and arid regions and its effects on population centers are discussed. Examples of erosion in various parts of Mexico are given and also methods of prevention that are being used. — EH

07749 **Jayaraman, A.; Cohen, Lewis H.** Phase diagrams in high-pressure research, *in* Phase diagrams, materials science and technology — V. 1, Theory, principles, and techniques of phase diagrams: New York and London, Academic Press, p. 245-293, illus., tables, 1970.

The applications of P-T diagrams in high-pressure research are discussed and illustrated with selected examples. Phase diagrams of elemental substances (helium, cesium, cerium, iron, etc.), in material synthesis (diamonds, etc.). and of significance to geophysical research are discussed and apparatus and techniques summarized briefly. Under geophysical applications three relatively simple systems of geological significance are examined: iron (of importance in core studies); the system SiO_2; and the system SiO_2-H_2O. — VSN

Jeffery, H. G. *See* Gann, E. E. 00535

Jeletzky, J. A. *See* King, Lewis H. 07674

00370 **Jensen, M. L.** Provenance of Cordilleran intrusives and associated metals: Econ. Geology, v. 66, no. 1, Bateman issue, p. 34-42, illus., 1971.

Sulfur isotope ratios of magmatic hydrothermal sulfides closely resemble that of meteoritic troilite suggesting a possible upper mantle source, as does the 0.705 Sr-87/Sr-86 ratio of Cordilleran intrusive whole rock analyses. Lead isotopes require model assumptions of deep crustal origin, but upper-mantle source is not excluded. Metal content of intrusives is believed to come from organic-rich shale horizons during penetration by the rising magma. Much of the water content of intrusives that is responsible for mineralization may be meteoric water activated by and perhaps drawn into the initially more anhydrous melt. Hydrogen sulfide migrated out beyond the top of the magma. — WSW

00432 **Jensen, M. L.** Stable isotopes of sandstone-type uranium deposits [abs]: Econ. Geology, v. 66, no. 1, p. 203, 1971.

07983 **Jesionek-Szymańska, Wanda.** On a new pygasterid (Echinoidea) from the Jurassic (Middle Lias) of Nevada, U.S.A. [with Polish and Russian abs.]: Acta Palaeont. Polonica, v. 15, no. 4, p. 411-419, illus., table, 1970.

Plesiechinus hawkinsi, n.sp., known only from the Lower Jurassic Sunrise Formation, at a horizon of upper Sinemurian age, at the type locality in Gabbs Valley Range, Nye County, Nev., is the oldest and most primitive species of Pygasteridae, a family characterized by morphology so like that of 'regular' echinoids that only the atrophied genital 5 plate and elongate periproct mark them as 'irregular.' The juvenile holotype of the new species, however, has the genital 5, with distinct genital pore, and the periproct completely within the apical system; it is not determinable whether the poorly preserved adult specimens are endocyclic or exocyclic, but the new species may represent the most primitive evolutionary stage of the 'irregulars.' Crenulate tubercles in this species contest earlier opinions that pygasterids were derived from smooth-tubercled echinoids. — VMJ

Joensuu, Oiva. *See* Bonatti, Enrico. 00570

Johnson, G. Leonard. *See* Watson, Jerry A. 07707

00427 **Johnson, J. G.** Lower Givetian brachiopods from central Nevada: Jour. Paleontology, v. 45, no. 2, p. 301-326, illus., tables, 1971.

Two brachiopod faunas, designated lower and upper, are described and form the basis of a revised *Warrenella kirki* Zone of early Givetian (Middle Devonian) age. *Parapholidostrophia*, type species *P. harperi*, is proposed as a new genus. New species include *Spinulicosta muir-woodi*, *Leiorhynchus miriam* (with new subspecies *miriam* and *alpha*), *Leptathyris index*, *Crurithyris calendae*, *Rhipidothyris circo*, *Parapholidostrophia harperi*, *Nemesa? cimex*, *Cassidirostrum vexans*. *Warrenella kirki kirki* (Merriam, 1940) is redescribed; populations of it include a relatively large number of remarkably elongate individuals. Provincial affinities and relations to major marine communities are discussed for brachiopods of this zone and the preceding (Eifelian) *Leptathyris circula* Zone. — *from* Author's abstract

07928 **Johnson, Richard Gustave.** Economic geology of a portion of the basal Duluth Complex, northeastern Minnesota [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 31, no. 6, p. 3481B, 1970.

Johnson, Robert L. *See* Rackley, Ruffin I. 00431

00462 **Johnson, Ross B.** Geologic map of the Laguna Ortiz quadrangle, San Miguel County, New Mexico: U.S. Geol. Survey Geol. Quad. Map GQ-956, scale 1:24,000, 1971.

Johnson, Tracy. *See* Oliver, Jack. 07687

Johnston, A. G. *See* Land, A. H. 07972

07814 **Jones, F. W.; Parker, M. L. G. S. C.** tree-ring scanning densitometer and data acquisition system: Tree-Ring Bull., v. 30, nos. 1-4, p. 23-31, illus., 1970.

A tree-ring scanning densitometer and data acquisition system has been built by the Geological Survey of Canada to extract tree-ring density and tree-ring width data from dendrochronological specimens and X-ray negatives of specimens. The system produces tree-ring density plots, ring density and ring-width bar graphs, and printed and punch tape digital data. This prototype was built primarily from commercial preconstructed electronic components, but a modified densitometer and other original-design units also were used. Crossdating between Engelmann spruce trees from Peyto Lake, Alberta, from 1890 through 1910, is illustrated by tree-ring density plots, ring-width bar graphs, and maximum-density bar graphs. — *from* Authors' abstract

00600 **Jones, J. G.** Aleutian enigma — A clue to transformation in time: Nature, v. 229, no. 5284, p. 400-403, illus., 1971.

This paper explores the possibility that in time, divergent plate boundaries may be transformed into convergent boundaries — that is, sources may become sinks. A model consistent with the history of the Aleutian arc and northern Pacific continental margin would involve two phases of nearly equal duration — simple plate accretion, followed by plate consumption along the northern perimter and continuing plate accretion along the eastern perimeter, the active zones connected by a ridge-to-arc transform fault. The crucial event in this hypothesis is transformation of the character of the northern perimeter of the Pacific plate from a source zone to a sink zone, some time after formation of the youngest of the east-west trending magnetic anomalies. Two major events in early Tertiary time may record this transformation. — DBV

Jones, J. Knox, Jr. *See* Dort, Wakefield, Jr. 08040

Jones, J. Knox, Jr. *See* Hoffmann, Robert S. 08052

Jordan, Tom. *See* Anderson, Don L. 00538

07852 **Jörgensen, P.; Low, P. F.** Conductance studies of Na-bentonite-water systems: Israel Jour. Chemistry, v. 8, no. 3, p. 325-333, illus., table, 1970.

Clay (Na-Wyoming bentonite) was mixed with water to form sols and gels having clay concentrations ranging from 0 to 60 gm clay per 100 gm; specific conductances of these sols and gels were measured at several temperatures in the range 20° to 25°C. From the results, the weight conductances and apparent activation energies for conductance were calculated; these quantities were plotted against clay concentration. Similar plots were made using the data of other investigators. It was found that weight conductance decreased markedly with clay concentration between 0 and about 0.5 gm of clay per 100 ml, then rose to a maximum at 10-20 gm clay per 100 ml, and fell steadily thereafter. Whereas, apparent activation energy increased continuously over the same range of clay concentrations. These observations are explained on the basis of equations derived theoretically. — *from* Authors' abstract

07929 **Jorgenson, David Bruce.** Petrology and origin of the Illinois River Gabbro, a part of the Josephine Peridotite-Gabbro Complex, Klamath Mountains, southwestern Oregon [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 31, no. 6, p. 3482B, 1970.

07894 **Jory, Lisle T.; Imrie, Alan S.** Geology and general features W.A.C. Bennett Dam, *in* Peace River, Pine Pass, Yellowhead 1970 — Edmonton Geol. Soc. Field Conf., 12th, Guidebook: Edmonton, Alberta, Edmonton Geological Society, p. 15-22, illus., 1970.

This dam, previously known as Portage Mtn. Dam, is located near the head of Peace River Canyon in British Columbia. The canyon is younger than the rest of the channel and upstream the river flows in a broad U-shaped valley. Before the Pleistocene the valley continued along the route now known as Rocky Mtn. Portage to Hudson Hope; sea-level was lower and the channel was cut to a very low base. A valley glacier left a moraine at Portage Pass which blocked the valley forming a lake that spilled over to the south establishing a new channel that became Peace River Canyon. The rock-canyon is an excellent foundation for the dam and quantities of construction gravels are present. Foundation rocks are Cretaceous sedimentary rocks; workings in a coal seam had to be back-filled. — ESL

Jouret, C. *See* Dran, J. C. 08019

Judd, James B. *See* Lynts, George W. 00537

Kanehiro, Y. *See* Agarwal, A. S. 00406

07722 **Karrow, P. F.; Terasmae, J.** Pollen-bearing sediments of the St. Davids buried valley fill at the Whirlpool, Niagara River gorge, Ontario: Canadian Jour. Earth Sci., v. 7, no. 2, pt. 1, p. 539-542, illus., tables, 1970.

Continued studies of the buried St. Davids gorge, an ancient valley of the Niagara River, have indicated that the upper part of this gorge was filled in mid-Wisconsinan time and later. Lacustrine sediments dated at 23,000 years B.P. were deposited in the gorge when the late Wisconsinan ice caused the water level to rise in the Lake Ontario basin by blocking the eastern outlet, prior to overriding the Niagara area. Palynological studies support the correlation of the dated lacustrine deposits in the gorge with the Plum Point Interstade of southern Ontario. — Authors' abstract

00491 **Kashef, Abdel-Aziz I.** On the management of ground water in coastal aquifers: Ground Water, v. 9, no. 2, p. 12-20, 1971.

Major elements that must be considered in management of coastal aquifers are: assimilation and use of available data scattered in various publications, files, and maps; a new type of hydrogeologic map that includes depth to aquifer boundaries, thickness of strata, distribution of similar aquifer characteristics, location of wells, water quality, salt-water interfaces, and other data; contamination by salt-water encroachment; recharge problems and future developments; relation between surface and ground water; leakage from impervious beds; resistance-capitance models (electric analogs); pumping out salt water as an approach to salt-water intrusion; and basic investigations to map three-dimensional salt-water mounds. — VSN

07930 **Kashuba, Andrew Thomas, Jr.** Analysis of terrestrial, meteoritic and lunar basaltic samples by spark source mass spectroscopy [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 31, no. 6, p. 3225B, 1970.

07992 **Kattner, Wilbur T.** (editor). Advances in dynamic gravimetry — Symposium, Fort Worth, Texas, 1970, Proc.: Pittsburgh, Pa., Instrument Society of America, 172 p., illus., tables, 1970.

This symposium was conducted as a pilot meeting to summarize recent and to forecast future developments in making gravity measurements from moving platforms. Three of the 16 papers presented are cited separately. — VSN

07994 **Kaula, William M.** Application of space and astromic techniques to solid earth and ocean physics, *in* Advanomic techniques to solid earth and ocean physics, *in* Advances in dynamic gravimetry (Wilbur T. Kattner, editor) — Symposium, Fort Worth, Texas, 1970, Proc.: Pittsburgh, Pa., Instrument Society of America, p. 130-135, 1970.

Recent developments in instrumentation indicate orders-of-magnitude improvement in measurement of mean sea level, tracking station positions, inertially referred directions, and gravity variations. Capabilities would enable space and astronomic techniques to make significant contributions to solving problems of driving forces and response mechanisms of global tectonic; pattern of general ocean circulation; rotational dynamics of the Earth, ranging from the geomagnetic dynamo to the seismic excitation of wobble; and mechanism of energy dissipation in oceans. — *from* Author's abstract

08054 **Keen, M. J.; Manchester, K. S.** The Mid-Atlantic Ridge near 45°N — [Pt.] 10, Sediment distribution and thickness from seismic reflection profiling: Canadian Jour. Earth Sci., v. 7, no. 3, p. 735-747, illus., tables, 1970.

The distribution of sediment on the crest mountains and high fractured plateau of the Mid-Atlantic Ridge at 45°N has been studied by seismic profiling. Sediment is ponded in intermontane valleys within the crest mountains and the plateau. It is also draped over the highlands of the plateau. Mean sediment thickness increases with distance from the valley out to 160 km, the limit of the study. The sediment data is not conclusive with regard to a break or change in the rate of the ocean-floor spreading betweeen 8 and 10 m.y. ago in this area. Rates of sedimentation have been a few cm/1000 yr during the past few m.y. It may have been more rapid in the past 100,000 yr. — Authors' abstract

08000 **Kehle, Ralph O.** Earth movements — An increasing problem in the cities, *in* Environmental geology — AGI short course lecture notes, Milwaukee, Wis., 1970: Washington, D. C., Am. Geol. Inst., 78 p., paged separately, illus., 1970.

The author discusses nonevident, unsuspected, slow earth movements which are prevalent, fairly easily predicted, simply avoided, and less costly to deal with than spectacular catastrophic movements. These movements include activity along faults, downslope motion, subsurface subsidence and collapse and differential ground movement, all of which are common in urban centers and will become more common and cause more damage at greater cost as the centers expand. Geologists must provide appropriate data to engineers and inform the public and officials of potential dangers of locating at certain sites. As future megalopoli expand, good geologic maps and evaluation of rock properties will be needed as well as reasonable building and grading codes, zoning and planning. — EH

Kelley, D. G. *See* Poole, W. H. 07973

Kemp, Patrick H. *See* Williams, Philip B. 00599

Kempton, John P. *See* Landon, Ronald A. 00596

00586 **Kennedy, E. Joyce; Ruch, R. R.; Shimp, N. F.** Studies of Lake Michigan bottom sediments — No. 7, Distribution of mercury in unconsolidated sediments from southern Lake Michigan: Illinois Geol. Survey Environmental Geology Notes 44, 18 p., illus., tables, 1971.

The mercury content of 132 unconsolidated sediment samples from 31 sampling stations in southern Lake Michigan was determined by a radiochemical separation technique. In the deep central portion of the southern part of the lake and in areas west of Benton Harbor, Mich., and southwest of Grand Haven, mercury has accumulated (0.1 to 0.4 ppm) in the uppermost sedimentary layers. A base level of 0.03 to 0.06 ppm mercury is found at depth in the cores. In sandy areas along the southern and southwestern shores no accumulation of mercury is apparent near the surface of the sediments; an accumulation at a lower interval is believed to be associated with the presence of metal sulfides. Mercury concentrations in the sediment-water interface samples vary with the organic carbon and total sulfur concentrations of the samples. — Authors' abstract

Kennedy, E. Joyce. *See* Ruch, R. R. 00601

Kennedy, G. C. *See* Higgins, G. 00564

00461 **Kepferle, Roy C.; Wigley, Perry B.; Hawke, B. Ray.** Geologic map of the Anchorage quadrangle, Jefferson and Oldham Counties, Kentucky: U.S. Geol. Survey Geol. Quad. Map GQ-906, scale 1:24,000, section, text, 1971.

Bedrock of Ordovician to Devonian age is overlain by Illinoian(,) and Wisconsin deposits. Limestone and dolomite for agriculture and industry are found in the Louisville Limestone and Laurel Dolomite, and fill material is obtained from the Waldrun Shale and loess deposits. Water is furnished in large amounts by the glacial outwash, and in lesser amounts from the base of the Jefferson and Louisville Limestones, and the Brassville Formation. Two of the shales become plastic when wet and pose engineering problems. No successful oil or gas wells have been drilled, although oil saturation is visible. Structure contours on the Waldrun Shale are shown on the map. — ESL

07886 **Kerr, J. W.** Geology of outstanding Arctic aerial photographs — [Pt.] 1, Cape Storm area, southern Ellesmere Island: Bull. Canadian Petroleum Geology, v. 18, no. 4, p. 463-468, illus., 1970.

Aerial Photograph A16756-149 of the Cape Storm area on the south coast of Ellesmere Island displays many geological features. The bedrock succession includes seven Ordovician to Devonian carbonate and shale formations, and embraces an Early Devonian unconformity. Structures include three main tilted fault blocks, major and minor faults, hinge faults, and a scissors fault. Major valleys contain braided streams and stream-borne alluvium. A broad raised beach that emerged in postglacial times has countless strand lines. — Author's abstract

07684 **Kerr, J. William.** Today's topography and tectonics in northeastern Canada [abs.], *in* Symposium on recent crustal movements, Ottawa, Canada, 1969, Papers: Canadian Jour. Earth Sci., v. 7, no. 2, pt. 2, p. 570, 1970.

07931 **Khattab, Khattab Mansour M.** Analysis of uranium and thorium and their daughter nuclides in uranium-thorium ores by high-resolution gamma-ray spectroscopy [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 31, no. 6, p. 3590B, 1970.

Kidwell, Albert L. *See* Langen, Raymond E. 00392

07799 **Kilinc, I. A.; Lyon, R. J. P.** Airborne infrared spectral study of igneous rocks, *in* Earth Resources Aircraft Program, status review, 2d Ann., Houston, Tex., 1969 — V. 2, Agriculture, Forestry, and sensor studies: Houston, Tex., U.S. Natl. Aeronautics and Space Admin., Manned Spacecraft Center, p. 26-1—26-21, illus., [1970,].

The object of Mission 78 of NASA Earth Resources Program, flown over Sonora Pass and Mono Lake test sites in 1968, was to test the feasibility of using a three-instrument IR pallet together with data recording system and to identify various rock types from the spectra. Target areas were in the high altitude granitic terrane of the Sierra Nevada. A stepwise discriminate function analysis program is used to identify the rock types. Drawbacks to this type of analysis and other aspects of the program are examined. — VSN

Kimbler, Oscar K. *See* Kumar, Anil. 08026

King, James E. *See* Mehringer, Peter J., Jr. 08048

07674 **King, Lewis H.; MacLean, B.; Bartlett, Grant A.; Jeletzky, J. A.; Hopkins, William S., Jr.** Cretaceous strata on the Scotian Shelf: Canadian Jour. Earth Sci., v. 7, no. 1, p. 145-155, illus., tables, 1970.

Continuous seismic-reflection profiles across the Scotian Shelf 100 km NNW of Sable Island, at a site where Cretaceous sediment samples were dredged, show well defined stratification within bedrock, truncated by submarine valleys which transect the area. The dredged material is from rubble heaps near the base of valley slopes. The 450 kg of sedimentary rock recovered consisted principally of sideritic quartz sandstone and arenaceous sideritic carbonate, both fossiliferous. Macrofauna suggest correlation with early Upper Cretaceous, and microflora and microfauna appear to correlate mainly with Albian-Aptian, and Albian-Cenomanian, respectively. Cretaceous strata immediately underlie much of central and eastern Scotian Shelf; Tertiary sediments overlie the Cretaceous toward the continental margin and occur as a discontinuous veneer at other shelf localities. — VSN

07679 **King, Lewis H.; MacLean, Brian.** Observations on Cretaceous outcrop from a submersible — Scotian Shelf: Canadian Jour. Earth Sci., v. 7, no. 1, p. 188-190, illus., 1970.

Direct observations from a submersible on a Cretaceous bedrock occurrence at 44°47′ N and 60°20′ W corroborate previous conclusions drawn from data obtained by remote sampling techniques. The direct observations provided additional detail. — Authors' abstract

00509 **King, Robert E.** 1971 exploration centers on new areas, gas search: World Oil, v. 172, no. 5, p. 65-68, illus., 1971.

Much of the money budgeted for U.S. wildcat operations this year will be spent in drilling for natural gas in the Anadarko basin of Oklahoma and Texas, the Delaware basin of West Texas, and offshore Louisiana. Because of recent oil discoveries, the Rocky Mountains, Michigan, and Florida also will be active drilling areas. Canadian efforts will concentrate offshore and in the far North. — Author's abstract

King, Robert E. *See* Halbouty, Michel T. 07768

00554 **Kinomura, N.; Koizumi, M.; Kume, S.** Germanate alkali feldspars under pressure: Jour. Geophys. Research, v. 76, no. 8, p. 2035-2037, illus., table, 1971.

It was experimentally confirmed that rubidium germanate feldspar $RbAlGe_3O_8$ transformed from a feldspar-type structure to a hollandite-like type under pressure. This result was consistent with those found in the cases of $NaAlGe_3O_8$ and $KAlGe_3O_8$. The lattice constants of the hollandite-like-type phases were observed to change by the substitution of alkali ions in $MAlGe_3O_8$ (M = Na, K, Rb). $LiAlGe_3O_8$ was an exception, decomposing to $LiAlGeO_4$ of spinel-type structure and GeO_2. — Authors' abstract

00407 **Kittrick, J. A.** Stability of montmorillonites — [Pt.] 1, Belle Fourche and Clay Spur montmorillonites: Soil Sci. Soc. America Proc., v. 35, no. 1, p. 140-145, illus., tables, 1971.

Seven samples of Belle Fourche and one of Clay Spur montmorillonite were equilibrated with various solutions for 3 to 4 years. Their solubility line on pH-1/3pAl^{3+} vs. pH_4SiO_4 axes was approached from both undersaturation and supersaturation, and its slope and intercept was in agreement with theoretical calculations. A ΔG of -2468.5 ± 0.3 kcal/mole was obtained for the two montmorillonites. — Soil brief

07862 **Klassen, R. W.; Wyder, J. E.; Bannatyne, B. B.** Bedrock topography and geology of southern Manitoba: Manitoba Dept. Mines and Nat. Resources Map 25-1970, scale 1:500,000, sections, descriptive notes, 1970; also in Canada Geol. Survey Paper 70-51, 1970.

The broad elements of bedrock topography, trends of major buried valleys, and drift thicknesses are delineated by contours and along three selected cross sections. Other variations in drift thickness undoubtedly occur along undiscovered buried valleys. Data were obtained from boreholes and well records. — ESL

Klemme, H. Douglas. *See* Halbouty, Michel T. 07768

00590 **Knochenmus, Darwin D.; Beard, Michael E.** Evaluation of the quantity and quality of the water resources of Volusia County, Florida: Florida Bur. Geology Rept. Inv., no. 57, 59 p., illus., tables, 1971.

Water used in 1967 in Volusia County, on the central east coast of Florida averaged about 25.9 mgd of which the major use (15.8 mgd) was for public supply. In the 20-yr interval 1950-70, the amount of ground water used for public supply will have more than doubled. It is estimated that 300 mgd is available. Ninety-five percent of the water comes from the Floridan aquifer; recharge is from rainwater, absorbed by unconsolidated sand of the clastic aquifer overlying the Floridan aquifer. Most high capacity wells withdraw water from the aquifer near the Atlantic Ocean and St. Johns River where presence of saline water limits well depths to about 300 feet. Deeper wells should be developed in the central part of the county where depth to saline water is as much as 1450 feet. Water in this aquifer is good chemical quality in most of the interior of the county; it is principally calcium bicarbonate type. — VSN

07932 **Knox, James Clarence.** Stream channel adjustment to physiographic factors in small drainage basins, Iowa and southwestern Wisconsin [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 31, no. 6, p. 3473B, 1970.

Koizumi, M. *See* Kinomura, N. 00554

07742 **Kornfeld, Joseph A.** Uinta basin oil discoveries increase Utah drilling: World Oil, v. 171, no. 5, p. 113-117, illus., 1970.

New oil discoveries in the Uinta basin of northeastern Utah have accelerated Rocky Mountain drilling activity. Nineteen drilling operations on 9,000-13,000 foot contracts now are under way in a three-county area. The area extends from Roosevelt and Bluebell fields in Uinta County, across the new Altamont, Cedar Rim and Sink Draw fields of Duchesne County, into southern Wasatch County 20 miles to the southwest. Production is concentrated in Tertiary Green River and Wasatch Formations. — GHD

08063 **Koster, F.; Baadsgaard, H.** On the geology and geochronology of northwestern Saskatchewan — [Pt.] 1, Tazin Lake region: Canadian Jour. Earth Sci., v. 7, no. 3, p. 919-930, illus., tables, 1970.

The rocks of the Tazin Lake region, north of Lake Athabasca, have been subdivided into three major complexes: the northeastern basement complex, mainly composed of a syn-to-late tectonic granodiorite-diorite series; a central meta-sedimentary and gneissic belt; and the Western granodiorite complex. Mylonitization, folding, and faulting are common in the centrally located meta-sedimentary and gneissic belt. Twenty new radiometric age determinations by the K-Ar method on biotite and amphibole of the granodiorite-diorite series average 2370 ± 40 m.y. Fragmentation of late tectonic basic dikes and remobilization of the granodiorite-diorite series have

been provisionally correlated with this established minimum age. The Western granodiorite complex was intruded 1900 m.y. ago. One biotite sample from White Lake granite of the meta-sedimentary and gneissic belt indicates an apparent K-Ar age of 1800 m.y. — Authors' abstract

Kraft, J. C. *See* Pickett, T. E. 00519

08027 **Krishna Murti, G. S. R.; Satyanarayana, K. V. S.** Discussion on the significance of magnesium and iron in montmorillonite formation from basic igneous rocks: Soil Sci., v. 110, no. 4, p. 287-288, 1970.

Soil montmorillonite analyses show wide variations in their chemical composition. Correlation analyses presented aim to show that iron is essential and more important than magnesium in the chemical environment for the formation of montmorillonite from basic rocks. The exact nature of the role of iron in the formation of montmorillonite is, however, not yet clearly understood. — JWH

Kron, Veronica B. *See* Rhodehamel, Edward C. 00534

Ku, L. F. *See* Dohler, G. C. 07690

Kudo, A. M. *See* Laughlin, A. W. 00490

07991 **Kühlmann, Dietrich H. H.** Die Korallenriffe Kubas — Pt. 1, Genese und Evolution [The coral reefs of Cuba — Pt. 1, Genesis and evolution (with German, English, and Spanish abs.)]: Internat. Rev. Gesamten Hydrobiologie, v. 55, no. 5, p. 729-756, illus., 1970.

Coral reefs in the West Indies differ from those in the Indian and Pacific Oceans in their location in sediment banks along the coasts, their retarded growth, and their small size. The development of submarine littoral terraces, peculiar to the reefs, is due to melting of continental ice and subsequent rise in sea level. The sea was cooled below 20°C, the temperature required for the existence of reef-forming corals. The reefs were formed in shallow water after a further sea-level rise and the sinking of the eastern part of the American land mass. Retarded growth and small size are due to repeated climatic and geophysical disturbances which killed reef-forming organisms and destroyed the reefs. Fossilization of the corals was due to the rapid transition of an area of destructive wave action into dry land and also because the corals were quickly covered by sediments. — *from* Author's abstract

08026 **Kumar, Anil; Kimbler, Oscar K.** Effect of dispersion, gravitational segregation, and formation stratification on the recovery of freshwater stored in saline aquifers: Water Resources Research, v. 6, no. 6, p. 1689-1700, illus., tables, 1970.

A calculation procedure, using analytical and empirical relations, to predict mixing and gravitational segregation in a horizontal radial flow system, yields results that agree well with experimental results with a three-dimensional laboratory flow model in which both mixing and gravitational segregation occurred simultaneously. The calculation procedure was applied to prediction of efficiency with which freshwater stored in saline aquifers might be recovered. Low aquifer water salinity, low formation permeability, and low formation thickness lead to the most favorable recoveries. The calculation procedure indicates that recovery efficiency improves with the number of injection-production cycles, suggesting that even for unfavorable conditions the process might become feasible on a long-term basis. Graphical presentations show the relative importance of several pertinent variables including formation stratification. — *from* Authors' abstract

Kume, S. *See* Kinomura, N. 00554

Kuo, John T. *See* Mason, Warren P. 00548

00445 **Kupsch, W. O.** Hector's geological explorations of the Canadian prairie west (1857-1859), *in* History of Canadian Geologists: Geol. Assoc. Canada Proc., v. 23, p. 31-41, portrait, 1971.

00575 **Kuroda, P. K.; Reynolds, M. A.; Sakamoto, K.; Miller, D. K.** Isotope anomalies in rare gases: Nature Phys. Sci., v. 230, no. 10, p. 42-43, illus., table, 1971.

This article is concerned with a set of new krypton data for the Bruderheim and Allende meteorites, from which it seems that there is a simple relationship between the abundance pattern and isotope anomalies in Ne, Ar, Kr, and Xe. The chief features of the raw gas isotope anomalies can probably be explained in terms of a mass fractionation. — DBV

07788 **Laguette G., C.** La explotación de los mares [Exploitation of the seas (with Spanish abs.)]: Inst. Mexicano Petróleo Rev., v. 2, no. 4, p. 20-29, 1970.

The more industrialized nations are preparing for intensive exploitation of ocean resources (energy, food, minerals, etc.). Perhaps in 15 years 53 percent of world production of hydrocarbons will be provided by submarine deposits; the Mexican Institute of Petroleum is developing a national marine technology. A brief resume is given of techniques already in use and of those in planning, development and testing, for exploring for hydrocarbons on the continental platforms and in the oceanic trenches. International law in exploiting the resources of continental platforms in accord with the Geneva Convention is discussed. — EH

07972 **Land, A. H.; Goodwin, A. M.; Mulligan, R.; Whitmore, D. R. E.; Gross, G. A.; Boyle, R. W.; Johnston, A. G.; Chamberlain, J. A.; Rose, E. R.** Economic minerals of the Canadian Shield, Chap. 5 *in* Geology and economic minerals of Canada: Canada Geol. Survey Econ. Geology Rept. 1 (5th edition), p. 151-226, illus., tables, 1970.

Of the wide variety of mineral commodities produced from the Canadian Shield the 10 most valuable produced in 1966, in descending order, are: iron, nickel, copper, zinc, gold, uranium, platinum group, silver, magnesium, and lead, altogether comprising 42 percent of Canada's total mineral production for that year. In this chapter the history of mineral exploration and techniques used are summarized. Seven structural provinces and their metallogenic associations are described as well as the metallogenic evolution of the Shield. Data are included on deposits and mines and the formations containing them, together with distribution maps or maps of individual orebodies, deposits or mines, broken down into radioactive elements, ferride metals, base metals, precious metals, minor metals and industrial minerals. — EH

00596 **Landon, Ronald A.; Kempton, John P.** Stratigraphy of the glacial deposits at the National Accelerator Laboratory Site, Batavia, Illinois: Illinois Geol. Survey Circ. 456, 21 p., illus., tables, 1971.

Identification and correlation of five informal rock-stratigraphic units in Wisconsinan glacial deposits at the NAL site provided stratigraphic data for preliminary engineering evaluation of foundation conditions. Lithologic and textural characteristics of representative samples from initial test borings differentiated major units; quantitative laboratory analyses of grain size and clay mineral composition provided data for differentiation and correlation. Engineering properties showed strong correlation with physical properties of tills and could be related to stratigraphic units. The units, from top to bottom, are: (A) surficial loess, local alluvial and lacustrine silt, and sand; (B) silty and clayey tills; (C) silty and sandy tills, with some water-laid silt, sand, and gravel; (D) till containing more than 50 percent clay; and (E) till with considerable amounts of outwash sand and gravel. — *from* Authors' abstract

00443 **Lang, A. H.** Contributions of W. E. Logan and G. M. Dawson to the Canadian mineral industry, *in* History of Canadian Geologists: Geol. Assoc. Canada Proc., v. 23, p. 19-23, portraits, 1971.

00373 **Lange, Ian M.; Cheney, Eric S.** Sulfur isotope reconnaissance of Butte, Montana: Econ. Geology, v. 66, no. 1, Bateman issue, p. 63-74, illus., tables, 1971.

Main Stage minerals show enrichment in S-34 outward from the central zone, perhaps due to increase in the pH of hydrothermal solutions as they moved upward and outward. The mean value for vein pyrite of the Deep Level zone is intermediate between those of the Central and Intermediate zones, as are those for copper sul-

fides. The order of S-34 enrichment among the minerals is proportional to bonding strengths. Isotopic evidence suggests that the vein systems were mineralized nearly simultaneously during the Main Stage. Preliminary data suggest a different isotopic composition for pre-Main Stage mineralizations. The isotope data suggest a genetic relationship of ore deposits and the Butte quartz monzonite. — WSW

00392 **Langen, Raymond E.; Kidwell, Albert L.** Geology and geochemistry of the Highland uranium deposit, Converse County, Wyoming [abs]: Econ. Geology, v. 66, no. 1, p. 207-208, 1971.

00523 **Lapham, D. M.; Faill, R.** 230 million years of rock missing: Pennsylvania Geology, v. 2, no. 1, p. 5, illus., 1971.

In an exposure uncovered during construction of an overpass on new U.S. 230 east of Harrisburg, Pennsylvania, a gap of 230 million years exists between Paleozoic shales and limestones and Triassic rocks directly above them. Possible explanations of this phenomenon are given. — EH

00524 **Lapham, D. M.** Native sulfur in Pennsylvania: Pennsylvania Geology, v. 2, no. 1, p. 14-15, illus., 1971.

The article briefly reviews six occurrences of native sulfur in Pennsylvania and describes two new localities, at Chestnut Hill, where limonite pseudomorphs occur, and on the surface of the ground over a burning underground coal bed at the Kehley's Run Mine near Shenandoah Heights, Schuylkill County. The former occurrence results from the alteration of a sulfide by oxidation and the latter is similar to the sulfur deposited by volcanic activity. — EH

00500 **LaQue, F. L.** Prospects for and from deep ocean mining: Marine Tech. Soc. Jour., v. 5, no. 2, p. 5-15, tables, 1971.

Manganese nodules represent the only deep ocean hard mineral resource, they occur over broad areas, and contain nickel, copper, and cobalt as well as manganese. Exploitation of nodules is likely to be economically attractive only if there is a market for more than one of the metals. Data are tabulated to show the extent to which ores of metals in nodules represent important resources of developing countries; there is no evidence that recovery from nodules will be more profitable than from land-based ores. If exploitation becomes economic, a limitation on the scale of operations may be imposed by international action for various reasons. Using proceeds from deep ocean metals for narrowing the gap of prosperity between highly developed and developing nations is likely to have a limited effect; data are given to show that substituting ocean for land sources would detract from rather than advance prosperity of developing countries. — VSN

00447 **Larochelle, A.** Note on the paleomagnetism of two diabase dykes, Anticosti Island, Quebec: Geol. Assoc. Canada Proc., v. 23, p. 73-76, illus., tables, 1971.

Paleomagnetic studies have been made on cores from two diabase dikes cutting the Ordovician Vaureal Formation on Anticosti Island. The larger dike has been dated by the K-Ar method as 138 ± 28 m.y. old, or as intruded at the Lower Cretaceous-Upper Jurassic boundary. The calculated virtual geomagnetic pole stands about halfway between the center of the Triassic cluster of North America and two presumed Jurassic poles reported for the White Mts. Intrusives and Lake Mistastin Volcanics. The Anticosti data, thus, support the view that the dike was inruded during Jurassic rather than Cretaceous. A Cretaceous age would suggest the interesting possibility that Anticosti Island has rotated clockwise about a vertical axis since dike emplacement. — VSN

07860 **Larson, Peggy Pickering.** Deserts of America: Englewood Cliffs, N.J., Prentice-Hall, Inc., 340 p., illus., 1970.

This book stresses the habitats of the deserts of North America. A chapter discusses the geological origin of deserts, water and wind as erosional agents, and other

mechanical, chemical and biological forces which reduce the rock to different varieties of soil. The remainder of the book is devoted to the climate, flora, fauna and people of the desert, with emphasis on their interrelationships. — EH

07718 **LaSalle, Pierre.** Notes on the St-Narcisse morainic system north of Quebec City [with French abs.]: Canadian Jour. Earth Sci., v. 7, no. 2, pt. 1, p. 516-521, illus., 1970.

The Lac St-Charles moraine is interpreted as part of the St-Narcisse moraine system. The stratigraphic position of the morainic sediments suggest that the Lac St-Charles moraine was deposited prior to the highest stand of the Champlain Sea in the Lac St-Charles area. — Author's abstract

07764 **Latham, Jack W.** Petroleum geology of Healdton field, Carter County, Oklahoma, *in* Geology of giant petroleum fields — Symposium, AAPG, 53d Ann. Mtg., Oklahoma City, Okla., 1968: Am. Assoc. Petroleum Geologists Mem. 14, p. 255-276, illus., tables, 1970.

Established in 1913, this field produced from four shallow Pennsylvanian sandstones recognized over most of the field. By 1955, about 2600 wells had been drilled in a producing area 7100 acres, some finding minor amounts of Ordovician oil. Since 1960, new production within the Arbuckle Group is from three dolomite zones; only the lowermost, the Brown, a 600-ft thick, highly fractured, crystalline dolomite is significant. The Arbuckle produces from an average depth of 3,900 feet; hydrocarbon entrapment is attributed to uplift and faulting in Morrowan time by the Wichita orogeny. A high-angle, 10,000-ft displacement put Pennsylvanian shales in juxtaposition with Ordovician carbonates, the younger providing a source and means of migration for most Arbuckle oil in the Healdton structure. Hoxbar sandstones, overlying the truncated rocks, have yielded 250 million bbl of oil from an average depth of 1000 feet. — GDC

Latour, B. A. *See* Little, H. W. 07975

00490 **Laughlin, A. W.; Brookins, D. G.; Kudo, A. M.; Causey, J. D.** Chemical and strontium isotopic investigations of ultramafic inclusions and basalt, Bandera Crater, New Mexico: Geochim. et Cosmochim. Acta, v. 35, no. 1, p. 107-113, illus., tables, 1971.

A new locality for lherzolite inclusions in basalt has been found in a cinder eruption of Bandera Crater, New Mexico. Red-spinel lherzolites had Sr-87/Sr-86 ratios of 0.7045-0.7055, green-spinel lherzolites 0.7023-0.7040 and basalt 0.7028-0.7034. The red spinel lherzolites apparently have no genetic relationship to the basalt. — Authors' abstract

00475 **Laverdière, Camille.** Sur quelques indicateurs glaciaires de la région de Chibougamau, Québec [On several glacial indicators (erratics) in the Chibougamau region, Quebec]: Rev. Géographie Montréal, v. 25, no. 1, p. 77-83, illus., 1971.

In this study, the bedrock sources and source localities of three glacial indicator boulders of dolomite are interpreted from bedrock outcrops and the direction of flow of the Scheffer glacial lobe as indicated by drumlin orientation and glacial striae. The indicators were reported from localities northwest, south, and northeast of Chibougamau Lake, respectively, and their source is the dolomitic Precambrian Mistassini Group, which crops out extensively all around the Mistassini Lake basin to the northeast, and its fossiliferous (*Cryptozoon*) unit, which crops out in the eastern part of the basin. Minimum distances traveled are estimated at 69 and 94 km for the first two indicators, if they come from the southern outcrop of the fossiliferous unit, or 110 and 146 km if they come from the northern outcrop, and 40 km for the third, which contains no fossils. — VMJ

00429 **Lawrence, David R.** Shell orientation in Recent and fossil oyster communities from the Carolinas: Jour. Paleontology, v. 45, no. 2, p. 347-349, illus., 1971.

Recent intertidal *Crassostrea virginica* (Gmelin) from Charleston County, S.C., show variability in the compass orientation of their planes of commissure. Scattered individuals have no preferred orientation, but two-fold vector means become increasingly significant as settings display more densely packed and more highly clustered oysters. The most significant of these vector means parallel the directions of current flow during the tidal cycle. Some factor, or factors, related to the hydrodynamic regime must influence shell orientation when these oysters occur as intact frameworks of organisms. A similar orientation pattern occurs in mid-Tertiary *C. gigantissima* (Finch) at Belgrade, N.C. These and other animal orientation studies could provide geologists with criteria for deciphering local current flow patterns in the geologic past. — *from* Author's abstract

07933 **Lawrence, James Robert.** O-18/O-16 and D/H ratios of soils, weathering zones and clay deposits [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 31, no. 6, p. 3482B-3483B, 1970.

07733 **Laycock, George.** The diligent destroyers: New York, Doubleday and Company, 225 p., illus., 1970.

This book decries the injuries inflicted on our environment by highways, reservoirs, strip mines, and estuary dredging. The Army Corps of Engineers, as our major water management agency, is examined at some length. Close behind comes the Bureau of Reclamation whose efforts are restricted largely to western states. The strip miners and shell dredgers are regional or local menaces; highway engineers are everywhere. There is some evidence of an awakening ecological conscience, but the rush to remodel America goes on, with no truly effective overall planning. As the works of man spread into remote corners of the land, the sacrifice of each remaining natural area assumes a growing importance. — GDC

LeCount, Peter F. *See* Comm. on Subsoils of Boston. 07865

Lee, K. Y. *See* Weir, Gordon W. 00459

08035 **Legget, Robert F.** The Ink Pots, a group of karst springs in the Rocky Mountains near Banff, Alberta — Discussion [of paper by R. O. van Everdingen, 1969]: Canadian Jour. Earth Sci., v. 7, no. 2, pt. 1, p. 551, 1970.

The original paper appeared in ibid., v. 6, no. 4, pt. 1, p. 545-554, 1969; Abs. North American Geology, February 1970.

LeMert, Rose Ann. *See* Grass, Luther B. 00409

Lepley, Larry K. *See* Adams, William M. 00404

00582 **Lepley, Larry K.; Adams, William M.** Audiomagnetotellurics: Jour. Remote Sensing, v. 2, no. 1, p. 8-12, illus., 1971.

The audiomagnetotelluric (AMT) method has been used on the Kona Coast of Hawaii, in conjunction with other geophysical methods, to estimate the depth to the sea-water interface with fresh water, or the underground structures that may control the movement of ground water. This paper briefly describes tha AMT theory, field method, and application to the basaltic terrane in Hawaii, with a novel interpretation procedure to detect the presence of anisotropy. — Authors' abstract

00420 **Lespérance, Pierre J.; Bourque, Pierre-André.** The Synphoriinae – An evolutionary pattern of Lower and Middle Devonian trilobites: Jour. Paleontology, v. 45, no. 2, p. 182-208, illus., tables, 1971.

The Synphoriinae are a valid subfamily of Dalmanitidae with numerous unifying features, essentially restricted to the Appalachians and adjacent areas, but with exceptional occurrences elsewhere in North America. Genera included are *Roncellia* (new), *Synphoroides* Delo, *Synphoria* Clarke, *Odontocephalus* Conrad, *Anchiopsis* Delo, *Coronura* Hall and Clarke, and *Trypaulites* Delo. New species are *Roncellia*

debeaujeuensis and *R. telosensis; Synphoria stemmata compacta* is a new subspecies; some previously established species are also described. Genera and species rejected from Synphoriinae, and species referred to it but requiring further investigation, are discussed. — REG

00379 **Lesure, Frank G.** Residual enrichment and supergene transport of gold, Calhoun mine, Lumpkin County, Georgia: Econ. Geology, v. 66, no. 1, Bateman issue, p. 178-186, illus., tables, 1971.

Chemical analyses of unweathered schist (sp. gr. 2.8) and schist saprolite (sp. gr. 1.65), recalculated to weight per volume, show a loss during weathering of large amounts of all major constituents, including silica, alumina, and total iron. Of the minor elements, Au and As show the most residual enrichment, but B, Be, Co, La, Nb, N, Pb, Zn, and Zr show some enrichment in saprolite. Elements showing losses include Ca, K, Mg, Na, and Sr. Weathering loss of 30 to 45 percent increases the gold content above the lower limit of detection. Gold in recently deposited limonite shows that some gold is also being transported with iron. — *from* Author's abstract

00391 **Levy, Enrique J.** Metallogenesis of Central America [abs]: Econ. Geology, v. 66, no. 1, p. 208, 1971.

07692 **Lewis, C. F. M.** Recent uplift of Manitoulin Island, Ontario, *in* Symposium on recent crustal movements, Ottawa, Canada, 1969, Papers: Canadian Jour. Earth Sci., v. 7, no. 2, pt. 2, p. 665-675, illus., table, 1970.

Recent emergence of the island was inferred from sediment sequences in 3 beach sites and 8 small lake basins at various altitudes up to 20 m above the Lake Huron. Organic sediment (gyttja) in each lake overlies clastic inorganic sand or silt, with the contact horizon demarcating the isolation of each basin as its threshold emerged from the high-energy littoral environment of Lake Huron. Radiocarbon dates and elevations of the basal gyttja sediments and organic beach sediments suggest uplift at a constant rate of 2.2 mm/yr over the past 5000 years. This rate refers to Little Current, Ontario, and is for movement relative to the outlet area of Huron basin at Sarnia, Ontario. The value agrees with basin tilting inferred from the lake level gauge observations made during the past 100 years. — *from* Author's abstract

08011 **Libby, W. F.** Radiocarbon dating, *in* A symposium on the impact of the natural sciences on archeology: Royal Soc. London Philos. Trans., ser. A, v. 269, no. 1193, p. 1-10, illus., 1970.

The first part of this paper reviews the history of the radiocarbon method, and discusses the apparatus and procedure. The second part is headed "Retrospect and Prospects." Two things have been learned: the method apparently is reliable on simultaneity but on absolute dates can be incorrect by as much as 600 or 700 years. The bristle cone pine tree-ring chronology shows the extent of deviations back to some 7,500 yr ago; the dates start becoming too young about 3,000 yr ago and continue deviating in that sense to what may be the peak deviation of some 700 years about 5,000 yr ago, when the deviation levels off. There is some evidence (from the Swedish varve chronology) for a decrease back to agreement at 10,000 to 11,000 years. In addition there is a somewhat erratic short-term fine structure. There is hope that the tree-ring calibration may be extended back to 10,000 yr. With the correction curve, we now can say that the currently accepted Egyptian chronology is probably correct. — DBV

08065 **Lichti-Federovich, Sigrid.** The pollen stratigraphy of a dated section of Late Pleistocene lake sediment from central Alberta: Canadian Jour. Earth Sci., v. 7, no. 3, p. 938-945, illus., tables, 1970.

The basal organic sediment in a 5.5 m section from Lofty Lake is radiocarbon dated at 11,400 yr old; a layer of Mazama ash was recognized at the 398 cm level. At the base, a *Populus-Salix-Sheperdia-Artemesia* pollen assemblage is unique in the late Pleistocene of North America and is interpreted as a pioneer forest; above this is the spruce-dominated assemblage, a pioneer boreal forest. There follows a tree birch-

dominated assemblage with poplar and hazel continuing to about 6,000 yr B.P. when a birch/alder-herb assemblage reaches maximum and is followed by a spruce-birch-alder assemblage which continued to the present. The apparent absence of grassland supports the hypothesis that there was never a late Pleistocene connection between the Peace River and the main southern grasslands. — *from* Author's abstract

Lilley, E. M. *See* Stephens, D. R. 07832

Lindsay, Everett H. *See* Mehringer, Peter J., Jr. 08048

Linehan, Daniel. *See* Comm. on Subsoils of Boston. 07865

08021 **Lipskiy, Yu. N.** Nekotoryye rezul'taty neposredstvennogo izucheniya poverkhnosti Luny [Some results of direct study of the surface of the Moon]: Akad. Nauk SSSR Vestnik, no. 10, p. 43-56, illus., tables, 1970.

Data on the Moon's surface obtained from Soviet and American lunar flights are summarized. The later flights, Apollo 11 and 12 and Luna 16, provided photographs and rock and soil samples which yielded valuable data on the cohesiveness and stability of the soil, mineral and chemical composition of the rocks, as well as their polarization and reflecting capacity. The age of crystalline rocks from the Sea of Tranquillity, determined by the Re-Sr and K-Ar methods, is about 3.7 b.y. ago. However, some dust and breccia were dated 4.6-4.7 b.y. and some other rocks at 2.3-4.4 b.y. — EH

07975 **Little, H. W.; Belyea, H. R.; Stott, D. F.; Latour, B. A.; Douglas, R. J. W.** Economic minerals of western Canada, Chap. 9 *in* Geology and economic minerals of Canada: Canada Geol. Survey Econ. Geology Rept. 1 (5th edition), p. 489-546, illus., tables, 1970.

The Cordilleran Region of Western Canada, divided into Eastern and Western Mineral Provinces, has produced 90 percent of the lead, half of the zinc and silver, and nearly one fifth of the copper in Canada to date, as well as 98 percent of the oil and natural gas and 44 percent of the coal production in 1965. Production of placer gold has been surpassed in importance by that of fuels. In the Eastern Mineral Province, characterized by relatively undisturbed sedimentary rocks, major economic minerals are petroleum, natural gas, coal and nonmetallic deposits such as evaporites, saline lake deposits, and structural materials. Petroleum, natural gas and coal occur chiefly in the southern Interior Plains with coal in the Eastern Cordillera. Metallic minerals, chiefly lead and zinc, are found in the western part. In the geologically complex Western Mineral Province metallic deposits with a variety of metals are widespread; lead, zinc, and copper are of greatest importance. Occurrences are described, broken down by metallic and nonmetallic deposits and fuels, with distribution maps and maps of individual deposits and mines. — EH

07726 **Loomis, Stuart R.** Morphology and ablation processes on glacier ice, *in* Icefield Ranges Research Project, scientific results, V. 2 (V. C. Bushnell and R. H. Ragle, editors): New York, Am. Geog. Soc., *and* Montreal, Quebec, Arctic Inst. No. America, p. 27-31, illus., revised 1970; originally published 1970.

Differential ablation on debris-laden glacier ice has long been recognized for its importance in producing ice-cored topographical features. A study of ablation rates on a medial moraine of the Kaskawulsh Glacier is used in conjunction with ice-flow data and an equilibrium hypothesis of mass movement in the debris mantle to explain the morphological form that the moraine assumes. — Author's abstract

Louke, Gladys P. *See* Dibblee, T. W., Jr. 08028

07911 **Loux, P. C.** Seismic motions from project Rulison, *in* Symposium on engineering with nuclear explosives — Am. Nuclear Soc. and U.S. Atomic Energy Comm., Las Vegas, Nev., 1970, Proc., V. 2: Springfield, Va., Clearinghouse Federal Sci. and Tech. Inf., p. 1069-1082, illus., 1970.

In the range from a few to a few hundred km, seismic measurements from the Rulison event are shown and compared with experimentally and analytically derived pre-event estimates. Seismograms, peak accelerations, and response spectra are given with a description of the associated geologic environment. Of particular interest is the close-in seismic frequency content which is expected to contain stronger high frequency components which translates into stronger accelerations within the first tens of km and affect safety preparations. Local geologic structure at nearby population centers must be considered. Pre-event reverse profile refraction surveys are used to delineate geology at Rifle, Rulison, Grand Valley, and other sites. Geologic parameters are used as input to seismic amplification models which give estimates of local resonant frequencies and improved safety against seismic effects hazards. — *from* Author's abstract

Low, P. F. *See* Jorgensen, P. 07852

08081 **Lowe, D. S.** Multispectral data collection and instrumentation studies, *in* Earth Resources Aircraft Program, status review, 2d Ann., Houston, Tex., 1969 — V. 2, Agriculture, Forestry, and sensor studies: Houston, Tex., U.S. Natl. Aeronautics and Space Admin., Manned Spacecraft Center, p. 25-1—25-13, illus., tables, [1970,].

Two programs (multispectral data collection and infrared instrumentation studies) for expanding and improving data collection with optical mechanical scanners are reviewed. In multispectral data the main collection ability is centered around scanners which allow simultaneous collection of imagery in as many as 19 wavelength bands. The results and status of the program at Michigan University are presented in tabular form; as of September 1969, 12 missions had been flown and 4600 flight line miles of data collected. The program on infrared instrumentation was designed to analyze data requirements of users and to conduct instrumentation and technique investigations to assure future data collection instrumentation capable of meeting these requirements. A multispectral scanner for an early Apollo flight is described briefly and illustrated. — VSN

Luce, Frederick D. *See* Skinner, Brian J. 00435

Lutzen, Edwin E. *See* Rockaway, John D., Jr. 07904

00410 **Lynn, W. C.; Tu, H. Y.; Franzmeier, D. P.** Authigenic barite in soils: Soil Sci. Soc. America Proc., v. 35, no. 1, p. 160-161, illus., table, 1971.

Authigenic barite has been identified in soil pedons in southeastern Oklahoma, eastern Texas, and northern Louisiana. The barite appears as fine, white powder on structural surfaces and in small pockets in the lower argillic horizon or just beneath it. — Authors' abstract

00537 **Lynts, George W.; Judd, James B.** Late Pleistocene paleotemperatures at Tongue of the Ocean, Bahamas: Science, v. 171, no. 3976, p. 1143-1144, table, 1971.

Estimates of paleotemperatures, based upon paleoecological analysis of planktonic foraminiferal thanatocoenoses of three piston cores from Tongue of the Ocean, Bahamas, indicate a maximum mean variation between late Pleistocene glacial and nonglacial stages of 3.6°C. The data also indicate that the Early Wisconsin glacial stage was 0.7°C warmer than the Late Wisconsin glacial stage. — Authors' abstract

Lyon, R. J. P. *See* Kilinc, I. A. 07799

08038 **MacChesney, J. B.; Rosenberg, P. E.** The methods of phase equilibria determination and their associated problems, *in* Phase diagrams, materials science and technology — V. 1, Theory, principles, and techniques of phase diagrams: New York and London, Academic Press, p. 113-165, illus., 1970.

Techniques for studying phase relations reviewed here include: static methods in which the temperature of the sample is held constant until equilibrium is attained; dynamic methods of phase equilibrium determination at other than ambient condi-

tions; and high pressure techniques of study. Under dynamic methods are discussed thermal methods of analysis, electrical conductivity measurements, thermal gravimetric analysis, vapor pressure measurements, EMF measurements on galvanic cells involving solid electrolytes, dilatometric methods, X-ray diffraction at high temperatures and pressures. Instrumentation is described and illustrated for all three methods. For geologic studies it is sufficient to identify a phase by a unique composition or range of compositions having a characteristic crystallographic structure. For purposes of technology, it is necessary to identify composition and major structural parameters and also deviations of these from ideal. — VSN

00458 **Macdonald, Gordon A.** Geologic map of the Mauna Loa quadrangle, Hawaii: U.S. Geol. Survey Geol. Quad. Map GQ-897, scale 1:24,000, section, text, 1971.

Lava flows from Mauna Loa fill the quadrangle, with those in the last 120 years separated chronologically. All the rocks in the quadrangle belong to the Kau Volcanic Series, all are tholeiitic, and both pahoehoe and aa types of flows are present. Volcanic features and flows are described at some length. The succession of prehistoric lavas is determined by superposition and weathering. Fault scarps border the caldera, and open cracks along rift zones are numerous. — ESL

07778 **MacDonald, H. C.** Effective radar look-directions for geologic interpretation, *in* Earth Resources Aircraft Program, status review, V. 1: Houston, Tex., U.S. Natl. Aeronautics and Space Admin., Manned Spacecraft Center, p. 9-1—9-22, illus., table, [1970,].

The synoptic presentation of side-looking radar systems in combination with an oblique angle of incident 'illumination' has provided enhancement of certain topographically expressed geologic features, such as faults and lineaments, which are neither obvious nor interpretable on conventional aerial photography. Recent multiple flight coverage from eastern Panama and northwestern Colombia has provided data for a semi-quantitative look-direction analysis. Geologic features selected for this study are faults, joint systems, and dip slopes. Specific examples from those areas of the United States with multiple pass coverage [Spanish Peaks, Colo.; Humboldt Range, Nev.; Boston Mts., Ark.] are compared with data from the Panama imagery, and it is apparent that look-direction does influence detectability of certain geologic features. — *from* Author's abstract

00450 **MacDonald, Harold C.; Waite, William P.** Soil moisture detection with imaging radars: Water Resources Research, v. 7, no. 1, p. 100-110, illus., 1971.

The effects of soil moisture have been extremely difficult to separate from other terrain parameters influencing the radar return signal. Data presented here suggest that dual polarized, K-band, side-looking imaging radars are capable of revealing a qualitative estimate of soil moisture content. When used as a supplement to airphotos in a temperate climate, radar imagery analysis will decrease the ambiguity of soil type reconnaissance. In the Arctic, an imaging radar may provide data for mapping permafrost. The use of additional multifrequency multipolarization imaging radars and the relative foliage penetration of each should be investigated as a possible means of gathering quantitative soil moisture information. — *from* Authors' abstract

00513 **Macdougall, D.** Deep sea drilling — Age and composition of an Atlantic basaltic intrusion: Science, v. 171, no. 3977, p. 1244-1245, table, 1971.

The fission track age of a basalt recovered from beneath Campanian sediments on the lower western flank of the Mid-Atlantic Ridge is 15.9 ± 1.6 m.y. The major element composition of a glassy margin of the basalt is similar to that of oceanic tholeiites except for a markedly high potassium concentration. — Author's abstract

MacIntyre, Ian G. *See* Pilkey, Orrin H. 00436

07888 **MacKenzie, W. S.** Allochthonous reef-debris limestone turbidites Powell Creek, Northwest Territories: Bull. Canadian Petroleum Geology, v. 18, no. 4, p. 474-492, illus., table, 1970.

Carbonate strata of the Devonian Ramparts Formation crop out west-northwest of Norman Wells. These sediments, about 100 ft thick and composed of lime muds, increase to about 800 ft in thickness a short distance to the west and are present in a reefal facies with corals and stromatoporoids. At Powell Creek about 53 ft of allochthonous beds consisting of argillaceous limestones and calcareous shales overlie reef-margin carbonates of the Ramparts. Large blocks of coral- and stromatoporoid-bearing limestone occur within thin-bedded argillaceous carbonates in the lower part of the unit, and graded echinoderm beds occur among overlying calcareous shales. The limestone blocks are allochthonous debris derived from the nearby carbonate bank. The graded echinoderm beds were deposited by turbidity currents which swept skeletal remains from relatively shallow water near the carbonate bank into deeper water. — *from* Author's abstract

MacKenzie, Warren S. *See* Toomey, Donald Francis. 08066

MacLean, B. *See* King, Lewis H. 07674

MacLean, Brian. *See* King, Lewis H. 07679

Maline, Stephen D. *See* Boucher, Gary. 00467

07891 **Mamet, B. L.; Mason, D.** Lisburne Group, lithostratigraphy and foraminiferal zonation British Mountains, northern Yukon Territory: Bull. Canadian Petroleum Geology, v. 18, no. 4, p. 556-565, illus., 1970.

Carboniferous carbonates of the British Mountains, northern Yukon Territory, consist of thin-bedded micritic mudstones, wackestones, and packstones overlain by massive wackestones, packstones and grainstones. These rocks contain seven foraminiferal assemblages ranging from Late Viséan (Meramec) to post Namurian (Atoka). Both the lithologies and the microfaunas indicate that these carbonates are the lateral equivalents of, and should be referred to, the Alapah and Wahoo Limestones, Lisburne Group, of northern Alaska. — Authors' abstract

Manchester, K. S. *See* Keen, M. J. 08054

07910 **Manghnani, Murli H.** Elastic parameters and infrared characteristics of glasses under high pressures and temperatures — U.S. Office Naval Research Contract N00014-67-A-0387-0005, NR 032-515, Final Rept.: Hawaii Inst. Geophysics [Rept.] HIG-70-30, 38 p., illus., tables, 1970.

Elastic parameters of 125 specimens of fused silica, silicate, borosilicate, and calcium aluminate glasses were investigated under atmospheric conditions and under pressures up to seven kb, and to temperatures of 400°C. The SiO_2 content plays an important role in the anomalous behavior of glasses. Elastic properties of Na_2O-TiO_2-SiO_2 glasses, and their pressure and temperature dependence are found to vary systematically with structural parameter Y. Substitution of Ca by Ba in the CaO-Al_2O_3-MgO-SiO_2-BaO glasses causes a direct increase in density and nonuniform decrease in moduli. Infrared absorption studies lead to the conclusion that the disordered structure of glass tends to become ordered under high pressure. — *from* Author's abstract

Mann, Ernest L. *See* Conn, Herbert K. 00384

00546 **Marcus, H. L.; Palmberg, P. W.** Comments on mechanical properties of iron meteorites and the structure of their parent planets: Jour. Geophys. Research, v. 76, no. 8, p. 2095, 1971.

It is proposed that a continuous equilibrium segregated region of phosphorus or other electronegative elements along ferrite-austenite interfaces and between phosphides and sulfides can serve as a source of a low-energy fracture surface in iron meteorites. This then makes it possible that iron meteorites may have been formed by fracture of a larger body. — DBV

Marshall, Frederick C. *See* Berry, William B. N. 00423

07876 **Martignole, J.; Schrijver, K.** The level of anorthosites and its tectonic pattern: Tectonophysics, v. 10, no. 4, p. 403-409, illus., 1970.

The conclusion that diapiric rising and lateral spreading of an anorthosite mass can induce considerable deformation in contiguous rocks is elaborated and applied to plutono-orogenic anorthosite masses in general. The tectonic pattern generated is characterized by domes and nappes, and can be explained by buoyancy of masses under an overburden of relatively dense, high-grade metamorphic rocks. Rising and spreading of solid anorthosite, under influence of gravity alone, also accounts for dependence of deformation pattern in overburden on shape of the mass. Eastern Grenville Province of the Canadian Shield, in which anorthositic rocks account for 20 percent of the surface area, is characterized by association of domical anorthosite masses and anorthosite nappes, separated by synclines and nappes of high-grade metamorphic rocks. Gravity could be the generating force of this disposition. — *from* Authors' abstract

Martin, Larry D. *See* Schultz, C. Bertrand. 08051

07845 **Martin, Robert Allen.** Fossil mammals of the Coleman IIA local fauna, Sumter County, Florida [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 31, no. 3, p. 1433B, 1970.

Maru, V. M. *See* Sarma, D. Gupta. 00477

Mason, D. *See* Mamet, B. L. 07891

00548 **Mason, Warren P.; Kuo, John T.** Internal friction of Pennsylvania slate: Jour. Geophys. Research, v. 76, no. 8, p. 2084-2089, illus., 1971.

Compressional-wave velocity and attenuation measurements have been made for Pennsylvania slate over a frequency range from 64 kHz to 15 MHz. All the internal friction values have been made for a direction parallel to the cleavage plane. The internal friction varies by a factor of 10 over this frequency range decreasing at the high frequencies and at the lower frequencies. The high-frequency measurements are consistent with the high-frequency component of dislocation damping with little pinning of the loops by impurity atoms. The drop-off at low frequencies with a leveling off at 10 kHz is consistent with a low-frequency dislocation component. The width of the dislocation distribution is less than exponential, which is in agreement with the cutoff of the long dislocation loops by the finite grain size. — Authors' abstract

08020 **Masuda, Akimasa; Nakamura, Noboru.** Evolution of lunar materials in light of the abundance variation of oxyphile trace elements: Contr. Mineralogy and Petrology, v. 29, no. 1, p. 11-27, illus., tables, 1970.

Based on the lunar data on lanthanides, U, Th, Ba, and Sr, the partition coefficients for fractional solidification were estimated for these elements. The resultant values suggest the removal of solids with perhaps pyroxenic composition. The partition coefficient for europium can be judged to be normal as divalent europium dominantly present in the melt. When we go back following the trend of fractionation of abundances, we can reach the stage where there is no europium anomaly and where the thorium concentration level is chondritic. It can be imagined that the material corresponding to this stage was directly original lunar material system. As a possibility, a zone melting is thought to be a possible process for the derivation of that material from chondritic material. The chondrite-normalized lanthanide patterns for silicate materials of two stony-irons appear to provide us with an intriguing clue to this problem. — *from* Authors' abstract

00510 **Mateker, Emil J., Jr.; Wu, Changsheng.** True amplitude data can indicate lithology: World Oil, v. 172, no. 5, p. 73-75, illus., 1971.

Reflection data taken in the field can be processed to show how changes in sand thickness as small as 10 percent affect amplitude of returning signals. Plotted as a

map, relative values can indicate significant lithologic information. — Author's abstract

07934 **Mather, Terry James.** Stratigraphy and paleontology of the Permian Kaibab Formation, Mogollon Rim, Arizona [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 31, no. 6, p. 3483B, 1970.

07935 **Mathews, Geoffrey William.** The petrology and geochemical variability of the Audubon-Albion stock, Boulder County, Colorado [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 31, no. 6, p. 3483B-3484B, 1970.

07694 **Mathews, W. H.; Fyles, J. G.; Nasmith, H. W.** Postglacial crustal movements in southwestern British Columbia and adjacent Washington state, *in* Symposium on recent crustal movements, Ottawa, Canada, 1969, Papers: Canadian Jour. Earth Sci., v. 7, no. 2, pt. 2, p. 690-702, illus., 1970.

In southwestern British Columbia and adjacent Washington State, submergent conditions are indicated at time of retreat of Vashon ice sheet, 13,000 yr ago. Northeast and north of this area, emergence was followed by submergence of hundreds of feet preceding Sumas ice advance. Following this, land became emergent and during the period 9000-6000 yr ago, sea level was about 35 feet below present in some parts of the area. The shore has stood close to its present level for the last 5500 yr in all parts of the area. Early movements were dominantly isostatic. Pre-Sumas submergence is of problematic origin. Sea-level shifts since 8000 yr ago are dominantly eustatic; isostatic movements were complete by this time. In historic time very small changes shown by tide gages and leveling may be tectonic. — *from* Authors' abstract

Mathur, Surendra P. *See* Adams, William M. 00404

Mattson, L. A. *See* Wright, H. E., Jr. 07732

07893 **Matwe, L.; Bos, C.** A discussion of the stratigraphy and structure in the Sukunka area of British Columbia, *in* Peace River, Pine Pass, Yellowhead 1970 — Edmonton Geol. Soc. Field Conf., 12th, Guidebook: Edmonton, Alberta, Edmonton Geological Society, p. 1-14, illus., tables, 1970.

In this area, 75 mi southwest of Dawson Creek in the Rocky Mtn. Foothills, four exploratory wells have been drilled with one successful gas well. Subsurface Triassic to Cretaceous beds include the Schooler Creek, Fernie, Minnes, and Bullhead Groups, with structures characterized by northwest-trending folds and southwest-dipping reverse faults. The Foothills are divided into Eastern and Western Belts, each of which is subdivided into two zones. The successful gas well produces from the Triassic Pardonet and Baldonnel Formations of the Schooler Creek Group at the crest of a faulted and fractured anticline. Structure sections are included. — ESL

Maurette, M. *See* Dran, J. C. 08019

07700 **Mayhew, Michael A.; Drake, Charles L.; Nafe, John E.** Marine geophysical measurements on the continental margins of the Labrador Sea: Canadian Jour. Earth Sci., v. 7, no. 2, pt. 1, p. 199-214, illus., table, 1970; erratum, ibid., no. 5, p. 1356, 1970.

Two high-velocity seismic layers under the inner shelf off northeast Labrador are tentatively correlated with Precambrian rocks onshore. Two sediment layers of variable thickness overlie the high-velocity layers and have accumulated to as much as 2 km thick in some localities. The crustal structure of the Labrador basin extends beneath the outer part of the shelf. No evidence is found from the seismic refraction measurements for fault-control of the marginal channels on the Labrador shelf. Where observed, they appear to be erosional in nature. Considerable relief is present in the high-velocity basement beneath the south Greenland slope and it appears to outcrop half way down the slope. — *from* Authors' abstract

07760 **Mayuga, M. N.** Geology and development of California's giant — Wilmington oil field, *in* Geology of giant petroleum fields — Symposium, AAPG, 53d Ann. Mtg., Oklahoma City, Okla., 1968: Am. Assoc. Petroleum Geologists Mem. 14, p. 158-184, illus., table, 1970.

This example of optimum conditions for oil is a broad asymmetric anticline with transverse normal faults dividing the reservoirs into many pools; late Miocene to early Pliocene in age, seven major zones produce mainly from varied sandstones, some from Jurassic(,) schist and overlying conglomerate. Unconformable on the Repetto Formation, 1800-2000 feet of nearly horizontal younger beds conceal the Wilmington structure, discovered in 1936. By 1968, over 1,156 billion bbl of oil had been produced; land subsidence of 29 feet attributed to losses in pressure, was reduced in rate and area by water injection which increased oil recovery. An additional 500-700 million bbl is estimated, and to the east, 1.0-1.2 billion bbl within 35-40 years, from six of the old zones of limited extent in the new Long Beach Unit or East Wilmington field. — GDC

07958 **McArthur, David S.; Onesti, Lawrence J.** Contorted structures in Pleistocene sediments near Lansing, Michigan: Geog. Annaler, Ser. A, Phys. Geog., v. 52A, no. 3-4, p. 186-193, illus., 1970.

Contorted beds within three drift sequences in the vicinity of Lansing, Michigan, are described and interpreted in terms of formational processes. Origin is ascribed primarily to foundering of sand laminations into incompetent underlying sediment of finer texture. Genetic distinctions are based on secondary processes responsible for substratum incompetence. In two sequences foundering is related to the quick condition of sediment immediately following deposition by running water; in a third sequence the suggestion is made that foundering followed seasonal thawing of ground ice. Contortions in drift sequences are not necessarily the product of periglacial processes, neither do contortions in drift supply proof of periglacial action. — Authors' abstract

07960 **McCloy, James M.** Hydrometeorological relationships and their effects on the levees of a small arctic delta: Geog. Annaler, Ser. A, Phys. Geog., v. 52A, no. 3-4, p. 223-241, illus., table, 1970.

During a geomorphic reconnaissance of Blow River delta, Yukon Territory, Canada, several constructional and destructional hydrometeorological processes affecting the levee system were recorded and analyzed; some of the levee features were found to differ significantly from those generally described. The paramount departure in the constructional phase occurred in the upper deltaic plain levees where eolian deposition has created levee heights in excess of flood stage. Lower deltaic plain levee construction is augmented by log accumulations on the eastern levees, resulting in height differences in paired levees. Destruction of the upper deltaic plain levees is characterized by thermo-erosional caverns which subsequently collapse and mask the bank; thereby protecting the previously exposed levee from erosion. The lower deltaic plain levees were found to be influenced by vegetative root binding during erosion. — *from* Author's abstract

00464 **McDowell, Robert C.** Geologic map of the Elizaville quadrangle, Fleming and Mason Counties, Kentucky: U.S. Geol. Survey Geol. Quad. Map GQ-893, scale 1:24,000, section, text, 1971.

A columnar section with description of the units is included. The brief text gives the economic geology of the quadrangle. Construction materials, mostly limestone, are furnished by all bedrock units. Ground water moves along fracture zones, forming sinks, caverns, and springs; the fractures are hazardous for construction and reservoirs. The map carries structure contours on the base of the Grant Lake Limestone. — ESL

00514 **McElhinny, Michael W.** Geomagnetic reversals during the Phanerozoic: Science, v. 172, no. 3979, p. 158-159, illus., table, 1971.

An analysis of worldwide paleomagnetic measurements suggests a periodicity of 350 m.y. in the polarity of the geomagnetic field. During the Mesozoic it is predominantly normal, whereas during the Upper Paleozoic it is predominantly reversed. Although geomagnetic reversals occur at different rates throughout the Phanerozoic, there appears to be no clear correlation between biological evolutionary rates and reversal frequency. — Author's abstract

McGlynn, J. C. *See* Stockwell, C. H. 07971

07743 **McGrain, Preston; Schwalb, Howard R.; Smith, Gilbert E.** Economic geology of Hancock County, Kentucky: Kentucky Geol. Survey County Rept., ser. X, 24 p., illus., tables, min. resources map, 1970.

Petroleum, coal, clay, shale, sand, gravel, and ground water are the principal geologic resources of Hancock County. Adequate reserves for new or expanded development of these commodities are indicated. Highway, rail, and water transportation is available. The Ohio River, with its modernized navigation locks and dams, permits economical movement of bulk, unprocessed materials over a large potential market area. Concurrent with Hancock County's present industrial growth should be an increased demand for geologic resources such as fuels, construction materials, and ground-water supplies. The presence of these could contribute significantly to the development and growth of this part of Kentucky. — Authors' abstract

07758 **McGregor, Alexander A.; Biggs, Charles A.** Bell Creek field, Montana — A rich stratigraphic trap, *in* Geology of giant petroleum fields — Symposium, AAPG, 53d Ann. Mtg., Oklahoma City, Okla., 1968: Am. Assoc. Petroleum Geologists Mem. 14, p. 128-146, illus., 1970.

In this important field in Powder River and Carter Counties, daily production of 50,000 bbl of oil should rise to 65,000 bbl; estimated reserves are 200 million bbl. A Lower Cretaceous stratigraphic trap along the Powder River basin's gently dipping east flank, near intersection of NE-trending littoral marine bars and a NW-trending delta system, the Muddy Sandstone was formed in nearshore environments of a regressive sea. Pinching out eastward between organic-rich shale layers, the sandstone tongues were tilted upward on the east soon after deposition, due to subsidence of the basin in which overlying Mowry Shale was deposited. Later subsidence further increased size and efficiency of the trap; at least four individual reservoirs are delineated in complex facies of Bell Creek field, an excellent example of major oil fields yet to be found in stratigraphic traps in the sparsely drilled rocky Mountain region. — *from* Authors' abstract

00382 **McGrew, Paul O.** The Tertiary history of Wyoming [abs]: Econ. Geol.ogy, v. 66, no. 1, p. 204, 1971.

McKenney, Dean B. *See* Slater, Philip N. 08083

McNeely, L. *See* Tank, R. W. 07878

08048 **Mehringer, Peter J., Jr.; King, James E.; Lindsay, Everett H.** A record of Wisconsin-age vegetation and fauna from the Ozarks of western Missouri, *in* Pleistocene and recent environments of the central Great Plains: Kansas Univ. Dept. Geology Spec. Pub. 3, p. 173-183, illus., table, 1970.

Excavations of two spring deposits in western Missouri resulted in the first radiocarbon-dated associations of Pleistocene biota from the Ozark Highlands. Although the pollen record is not complete, three distinct assemblages are recognized. From about 32,000 to 13,500 years ago pollen dominance changed from NAP-pine, to spruce dominance, to spruce with deciduous elements. Mastodon (*Mammut americanum*) was the most abundant mammal recovered. It was associated with horse and muskox in sediments dominated by NAP-pine pollen, and with giant beaver and ground sloth in deposits with spruce and deciduous tree pollen, and spruce macrofossils. — Authors' abstract

Mehrotra, P. N. *See* Stearn, C. W. 07980

08076 **Meier, M.; Edgerton, A. T.** Snow and ice sensing with passive microwave and ground truth instrumentation — Recent results, South Cascade Glacier, *in* Earth Resources Aircraft Program, status review, 2d Ann., Houston, Tex., 1969 — V. 3, Hydrology and oceanography: Houston, Tex., U.S. Natl. Aeronautics and Space Admin., Manned Spacecraft Center, p. 43-1—43-15, illus., table, [1970,].

The application of passive microwave sensing for synoptic monitoring of snowpacks and glaciers has been tested in field experiments utilizing multifrequency microwave radiometry in the Pacific Northwest to assess effects of melting, layering surface roughness, density variations, etc. on microwave emission, and to determine effective penetration as a function of sensor wavelength. Studies were conducted over South Cascade Glacier and over Mount Rainier. Accompanying laboratory studies were carried out to determine dielectric properties of snowpacks at microwave frequencies, and surface tests were conducted on South Cascade Glacier to develop techniques for determining snow moisture. — VSN

Meleskie, K. R. *See* Parker, M. L. 07815

07802 **Mel'nik, V. I.** Geologicheskiye issledovaniya v Meksikanskom zalive i Karibskom more [Geological investigations in the Gulf of Mexico and the Caribbean Sea (with English and Spanish abs.)], *in* Okeanologicheskiye issledovaniya, Sbornik statey, no. 20 — Rezul'taty issledovaniy po mezhdunarodnym geofizicheskim proyektam: Moscow, Izdatel'stvo "Nauka," p. 22-41, illus., tables, 1970.

Soil cores and bottom scoop samples taken in the south part of the Gulf of Mexico, on the continental slope of the south coast of Cuba and in the Straits of Florida and the Bahamas, were analyzed for pH, Eh, color and for $CaCO_3$ and $MgCO_3$ content. Sediments in the Gulf of Mexico are mostly of clastic origin. An extensive development of suspension streams was found on the slope south of Cuba. Traces of volcanic activity were discovered in the Yucatan Strait. The presence of limestone of Pleistocene age in the Straits of Florida indicates that strong bottom currents existed there. — *from* Author's English abstract

00602 **Mero, John L.** Will ocean mining prove commercial,: Offshore, v. 31, no. 4, p. 118, 120-121, 123-124, 126-128, 131, 133-134, illus., tables, 1971.

Mineral deposits of the sea are of current interest largely because calculations indicate that the sea is a much less expensive source of supply; lower mining costs are partly due to lower risk capital in developing certain deposits. Mineral deposits are found on continental shelves (calcareous shell deposits, phosphorite, glauconite, and gravel, placer deposits of metals, hot brines, etc.), marine beaches (placers of gold, platinum, diamonds, ilmenite, etc.), sea water (salt and various metals, gypsum, sulfur, etc.), subsea-floor rocks (oil, gas, sulfur, salt, coal, iron, etc.), and deep-sea floor (clays, oozes, animal remains, zeolite, manganese nodules). Problems of mining, exploration, processing, and reserves are discussed. — VSN

07989 **Merritt, Melvin L.** Physical and biological effects, Milrow event — U.S. Atomic Energy Comm. NVO-79: Springfield, Va., Natl. Tech. Inf. Service, 113 p., illus., tables, 1970.

Effects of the Milrow nuclear detonation of about one-megaton yield, fired 4,000 feet deep on Amchitka Island, Alaska, on October 2, 1969, are given. Data are included on ground and underwater shocks, surface phenomena, radioactivity of ground and surface water, and biologic, seismic, and tsunami effects. An account of the geologic and tectonic setting and history and of the seismicity of the area is included. Seismic effects of Milrow were similar to those of Nevada Test Site shots of similar yield. Local ground motions did not cause measurable waves in the sea and, as no major earthquake was triggered, no tsunami occurred. As there was no detectable release of radioactivity, surface and ground water were not immediately affected, although ground water collecting in the chimney of the cavity could later carry tritium to the ocean. — EH

Meyer, Henry O. A. *See* Haggerty, Stephen E. 08018

Meyerhoff, A. A. *See* Halbouty, Michel T. 07768

07673 **Miall, A. D.** Continental marine transition in the Devonian of Prince of Wales Island, Northwest Territories: Canadian Jour. Earth Sci., v. 7, no. 1, p. 125-144, illus., tables, 1970.

The Peel Sound Formation, eastern Prince of Wales Island, is described as an example of coastal alluvial plain sedimentation with a well developed marine equivalent. Five facies are described which show a gradation from coarse conglomerates near the source area (Boothia axis), through red sandstones to gray, nonmarine clastics to marine carbonates. "Paleocurrent evidence indicates an easterly source, confirmed by conglomerate clasts derived from Boothia Uplift, an area of lower Paleozoic and Proterozoic rocks extending northwards from Boothia Peninsula to Somerset Island." — VSN

08073 **Miall, Andrew D.** A new Lower Devonian rock unit in the Canadian Arctic Islands — Discussion [of paper by A. R. Ormiston, 1969]: Canadian Jour. Earth Sci., v. 7, no. 3, p. 1027-1029, illus., 1970.

Vertebrate fossils from clastic rocks of the Peel Sound Formation on north-central Prince of Wales Island indicate that rocks as young as Emsian may be present, contrary to the statement of Ormiston [ibid., v. 6, no. 5, p. 1105-1111; Abs. North American Geology, March 1970] (1969) that Siegenian to Emsian carbonate sediments on northwestern Prince of Wales are the youngest rocks present on the island. A revised cross-section through northern Prince of Wales shows Ormiston's carbonates as a facies variation of the Peel Sound Formation, which rests on the underlying Read Bay Formation with a generally gradational contact, not a regional unconformity. — Author's abstract

00544 **Michard, Gil.** Theoretical model for manganese distribution in calcareous sediment cores: Jour. Geophys. Research, v. 76, no. 9, p. 2179-2186, illus., tables, 1971.

A steady state model for manganese distribution in calcareous sediment cores is presented. In this diffusion-advection model, the chemical reactions involved are (1) Mn^{++} is oxidized in the top of the core, and (2) Mn^{++} is sorbed on the solid phase in the reducing conditions of the bottom. A general mathematical solution is given. A numerical statement is given for calcareous cores. — Author's abstract

00393 **Michener, Charles E.** Geotectonics, mantle material, and ultrabasics [abs]: Econ. Geology, v. 66, no. 1, p. 208, 1971.

Miller, D. K. *See* Kuroda, P. K. 00575

07766 **Mills, Herbert G.** Geology of Tom O'Connor field, Refugio County, Texas, *in* Geology of giant petroleum fields — Symposium, AAPG, 53d Ann. Mtg., Oklahoma City, Okla., 1968: Am. Assoc. Petroleum Geologists Mem. 14, p. 292-300, illus., 1970.

This field on the Gulf Coastal Plain has large accumulations of oil in the regressive Oligocene Frio Formation, with increasing percentages of associated gas in its progressively younger sandstones — primarily gas with minor oil columns in the transgressive Anahuac Formation, and dry gas in the regressive Pliocene-Miocene Fleming sandstone. Ultimate recovery of 500 million bbl of oil and 1 trillion cu ft of gas is expected. Entrapment is the result of anticlinal folding on the downthrown side of Vicksburg fault zone. Deep-seated plastic shale on continental shelf-edge or slope, slumping away from faults, converged into support for the dominant Tom O'Connor structure, first and largest trap in the path of hydrocarbons migrating upward from deeper source areas. The massive, permeable, inner- to middle-shelf Frio sandstone beds, structurally uninterrupted for 10-15 mi towards source areas, provided a large drainage system. — GDC

07688 **Milne, W. G.; Smith, W. E. T.; Rogers, G. C.** Canadian seismicity and microearthquake research in Canada, *in* Symposium on recent crustal movements, Ottawa, Canada, 1969, Papers: Canadian Jour. Earth Sci., v. 7, no. 2, pt. 2, p. 591-601, illus., 1970.

In 1968, three high-frequency, high-gain seismographs were operated for six weeks in a large area north and east of Quebec City where precise levelling had disclosed differential vertical movement of about 1.25 feet (about 0.38 m) per century. Few microearthquakes were observed. During three months of similar monitoring near Mount Edziza, B.C., only about 20 small earthquakes originated near the volcano, but approximately 8000 shocks with $M \leq 3$ occurred west of the Stikine River near the Alaskan border. Only further research will establish whether microearthquake studies can give us a useful measure of Canadian seismicity. — *from* Authors' abstract

07936 **Minard, Lane Hall.** Chemical relations between coexisting minerals in a progressively metamorphosed pelite [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 31, no. 6, p. 3480B, 1970.

00455 **Mixon, R. B.; Harris, L. D.** Geologic map of the Swan Island quadrangle, northeastern Tennessee: U.S. Geol. Survey Geol. Quad. Map GQ-878, scale 1:24,000, sections, text, 1971.

Columnar sections of Ordovician units in the Clinchport and Copper Creek fault belts, and one for the Paleozoic rocks in the quadrangle are included. Zinc and some stone are the only economic products. — ESL

Moench, Allen F. *See* Schicht, Richard J. 00494

00501 **Mooney, N. T.** Measurements of the engineering properties of marine sediments: Marine Tech. Soc. Jour., v. 5, no. 2, p. 21-30, 1971.

Instruments currently used to measure engineering properties of marine sediments in situ are evaluated with respect to actual performance and required accuracies. The inherent difficulties of measuring these properties in the laboratory rather than in situ are reviewed, and test results are provided which indicate existing sampling devices and procedures produce questionable results. Measurement of shear strength of sediments is of particular interest to engineers, and development of an in situ direct shear device is recommended, with a description of how such an instrument could function. — Author's abstract

07754 **Moody, J. D.; Mooney, J. W.; Spivak, J.** Giant oil fields of North America, *in* Geology of giant petroleum fields — Symposium, AAPG, 53d Ann. Mtg., Oklahoma City, Okla., 1968: Am. Assoc. Petroleum Geologists Mem. 14, p. 8-18, illus., 1970.

Forty-five oil fields with recognized ultimate recoveries larger than 500 million bbl have been found in seven provinces in North America. The earliest find was in 1865 and the latest in 1962. Recognition of more recent discoveries as giants will probably increase the population to 51 fields. Examination of reservoir age, lithology, trap and depositional environment leads to the conclusion that there are no diagnostic characteristics common to all of the giants; however, Paleozoic age, shallow-marine environment, sandstone lithology, and structural traps which have surface expression are the preferred modes. Uncommonly thick reservoir rock or unusual development of porosity and permeability are not required. Twenty-five to twenty-eight more giant oil fields remain to be found, based upon current projections. Under present, or slightly improved, exploration economics the twenty-fifth future giant may not be found until 2060. — Authors' abstract

00398 **Mookherjee, Asoke.** Deformation of pyrite [discussion of paper by J. L. Graf and B. J. Skinner, 1970]: Econ. Geology, v. 66, no. 1, Bateman issue, p. 200, illus., 1971.

A specimen from Manitouwadge, Ontario, suggests "that in nature there is some evidence of plastic deformation of pyrite, though possibly under unusual conditions" and sluggish strain rates. For original paper, *see* ibid., v. 65, no. 2, p. 206-215; Abs. North American Geology, March 1971. — WSW

Mooney, J. W. *See* Moody, J. D. 07754

Moore, D. P. *See* Westermann, D. T. 00405

00380 **Moore, George W.** Geologic significance of the minor-element composition of marine salt deposits: Econ. Geology, v. 66, no. 1, Bateman issue, p. 187-191, illus., tables, 1971.

Detailed chemical analyses of marine halite rock ranging in age from Cambrian to Holocene are compared. If evaporite deposits reflect the geologic history of sea water, then a similar composition of rock salt of differing ages suggests that the ratio between ions in sea water has remained approximately constant since Cambrian time. Certain elements, such as strontium and boron, are depleted in marine halite rock because they are deposited respectively earlier and later in the evaporation sequence. Lead is enriched a thousandfold, possibly because of heavy-metal concentration by micro-organisms. — Author's abstract

07800 **Moore, Richard K.** Radar and data processing, *in* Earth Resources Aircraft Program, status review, 2d Ann., Houston, Tex., 1969 — V. 2, Agriculture, Forestry, and sensor studies: Houston, Tex., U.S. Natl. Aeronautics and Space Admin., Manned Spacecraft Center, p. 32-1—32-28, illus., [1970,].

Research in radar and data processing at the University of Kansas in 1968 is reviewed. Results indicate that the panchromatic radar technique and other averaging methods will be most important in earth resources radar imaging systems to improve gray scale rendition. Soon it should be possible to have continuous spectral signatures across an octave in the microwave regions. The 16.5 GHZ SLAR on MSC aircraft is marginally acceptable, but a new polypanchromatic synthetic aperture system for the aircraft program should be started as soon as possible. By combining systems such as KANDIDATS and IDECS, an integrated real-time or near real-time data processing system can be built. — VSN

Moore, William J. *See* Field, Cyrus W. 00372

07836 **Morrison, Bert C.** An electrical potential method used at a single hole to indicate direction to better mineralization [abs.]: Mining Eng., v. 22, no. 9, p. 52, 1970.

Morrison, Michael F. *See* Northrop, John. 00558

00444 **Morton, W. L.** Henry Youle Hind, geologist (1823-1908), *in* History of Canadian Geologists: Geol. Assoc. Canada Proc., v. 23, p. 25-29, portrait, 1971.

08006 **Mountjoy, Eric W.** Geology of the Main Ranges between Tete Jaune Cache and Jasper, *in* Peace River, Pine Pass, Yellowhead 1970 — Edmonton Geol. Soc. Field Conf., 12th, Guidebook: Edmonton, Alberta, Edmonton Geological Society, p. 94-107, illus., tables, 1970.

The first part of the trip crosses a structural unit forming the Selwyn Range, in which middle Miette strata are complexly folded and faulted. The middle part, southeast of Mt. Robson, follows the Moose Lake thrust, which separates the Paleozoic Mt. Robson syncline from the Precambrian of the Selwyn. The final part of the trip crosses the Mt. Robson syncline, and Moose Pass, Monarch, Snaring, and Pyramide thrust sheets. Near Tete Jaune Cache, the Rocky Mtn. Trench is two to four miles wide and filled with alluvium and glacial deposits. One or more major thrust faults are present beneath the Trench. Other sections of the trip route described are: Tete Jaune Cache to Mt. Robson (western Main Ranges), Mt. Robson to Yellowhead Pass (boundary between Ranges), and Yellowhead to Jasper (eastern Main Ranges). A stratigraphic table is included. The paper closes with a structural summary. — ESL

Mountjoy, Eric W. *See* Toomey, Donald Francis. 08066

Mudie, John D. *See* Akker, F. B. van den. 07801

Mueller, Ivan I. *See* Arur, M. G. 00550

07825 **Mueller, R. A.** Prediction of seismic motion from contained and excavation nuclear detonations, *in* Symposium on engineering with nuclear explosives — Am. Nuclear Soc. and U.S. Atomic Energy Comm., Las Vegas, Nev., 1970, Proc., V. 2: Springfield, Va., Clearinghouse Federal Sci. and Tech. Inf., p. 1051-1068, illus., 1970.

The capability to predict ground motions from nuclear events is developed on empirical and theoretical bases. Analyses of experimental data provide basic predictions of peak particle motions and spectra which follow a yield^{m} × distance^{-n} relation. Exponents on yield and distance are frequency dependent and derived from experiment and theory. For example, yield scaling theory predicts significantly higher frequency motions and consequently larger ground accelerations for overburied events (Gasbuddy, Rulison, Wasp, Wagon Wheel). This result is important in assessing probability of property damage. Theory predicts lower ground accelerations for excavation events. Scattering theory determines a distance exponent which predicts greater attenuation effects on higher frequency motions. In addition to source and transmission factors, current ground motion prediction techniques take into account local site characteristics. — *from* Author's abstract

Muffler, L. J. P. *See* White, D. E. 00374

Muller, O. *See* Allen, R. O. 07907

Mulligan, R. *See* Land, A. H. 07972

00470 **Murphy, J. R.; Davis, A. H.; Weaver, N. L.** Amplification of seismic body waves by low-velocity surface layers: Seismol. Soc. America Bull., v. 61, no. 1, p. 109-145, illus., 1971.

The phenomenon of frequency-dependent amplification of seismic waves by near-surface low-velocity layers was examined from analytic and experimental viewpoints for P, SV, and SH waves. Ground-motion data recorded in conjunction with underground nuclear testing are used for experimental validation of analytic models. Experimental amplification factors are derived for a variety of recording-site near-surface geologic configurations and a wide dynamic range of ground-motion intensity. The variability in mean amplification observed at a site for repeated measurements is described statistically. It is found that amplification at a site varies from detonation to detonation, but frequency and magnitude of the dominant amplification are fairly consistent. Available linear analytic models are capable of describing major features of the frequency-dependent amplification observed for this wide range of ground-motion intensity and recording-site geology. — *from* Authors' abstract

07937 **Murray, Marc Michael.** Petrology, structure, and origin of the San Isabel batholith, Wet Mountains, Colorado [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 31, no. 6, p. 3484B, 1970.

Nafe, John E. *See* Mayhew, Michael A. 07700

Naftel, W. L. *See* Gabrysch, R. K. 08031

Nakamura, Noboru. *See* Masuda, Akimasa. 08020

07938 **Namy, Dominique.** An investigation of certain aspects of stress-strain relationships for clay soils [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 31, no. 6, p. 3380B, 1970.

07796 **Napier, John.** The roots of mankind: Washington, D.C., Smithsonian Institution Press, 240 p., illus., tables, 1970.

This book is a cross between a scientific textbook and a layman's guide to evolution; it grew out of a series of lectures delivered in 1969 to Friends of the National Zoo, Washington, D.C. Chapter headings are: a giraffe's eye view; evolutionary theory and the meaning of species; the world of primates; habit and habitat; monkeys in motion; apes in the attic; man in the offing; man in the making; and man alive. Emphasis is on genesis of man's physical and some of his behavioral characters, compared to those of other primates. — GDC

Nasmith, H. W. *See* Mathews, W. H. 07694

07939 **Neasham, John West.** Sedimentology of the Willwood Formation (lower Eocene) - an alluvial molasse facies in northwestern Wyoming, U.S.A. [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 31, no. 6, p. 3484B, 1970.

Neathery, Thornton L. *See* Wampler, J. Marion. 07734

Neathery, Thornton L. *See* Alabama Geological Society. 07735

Nehru, C. E. *See* Bhattacharji, S. 07680

00480 **Nelson, Henry F.** Stratigraphy and history of the Holocene sediments in the Sabine-High Island area, Gulf of Mexico [abs.]: Corpus Christi Geol. Soc. Bull., v. 11, no. 7, p. 2-3, 1971.

Nelson, Jerome S. *See* Amimoto, Perry Y. 07839

07940 **Nelson, Robert Stanley, Jr.** The glaciation of the headwaters area of Clear Creek, Bighorn Mountains, Wyoming [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 31, no. 6, p. 3484B-3485B, 1970.

00532 **Neuerburg, George J.** Maps showing distribution of selected accessory minerals in the Montezuma stock, Summit County, Colorado: U.S. Geol. Survey Misc. Geol. Inv. Map I-608, scale 1:48,000, text, 1971.

Accompanying the geologic map, six mineral maps at scale 1:31,680 show distribution of sulfides, molybdenite, manganese, magnetite, zircon, and the degree of rock alteration. The distribution patterns of minor accessory minerals should record conduits through which late magmatic fluids moved. The Montezuma stock is Tertiary and intrudes folded and faulted Precambrian, and Cretaceous shale. Most of the stock is coarse-grained porphyritic rock. The associated ore deposits are part of the Front Range mineral belt. Argillic wallrock alteration occurs in many deposits. The stock is divided into three areas of mineralization. Distribution patterns of accessory minerals are a guide to ore. — ESL

00533 **Neuerburg, George J.** Maps showing soil analyses of interest for prospecting the Montezuma stock, Summit County, Colorado: U.S. Geol. Survey Misc. Geol. Inv. Map I-634, scale 1:31,680, text, 1971.

The nine maps cover mineralized bedrock localities, ore solution conduits in bedrock, and the ppm in soils adjacent to bedrocks of lead, antimony, zinc, tellurium, silver, copper, and mercury. The stock, composed of biotite-quartz monzonite, is intruded by large granite-aplite masses. Ore deposits associated with the stock are in the upper part or the Precambrian above it. Characteristics of the deposits change vertically. The stock is divided into three mineralogic areas. Soil samples were collected from 531 localities. Arsenic, bismuth, and gold are spatially random and serve no purpose. Silver, lead, zinc, copper, and antimony correlate with mineralized areas in area 3 of the stock. Tellurium and mercury have high vapor pressures and may form halos over deeply buried deposits. — ESL

07866 **Newell, Norman D.; Boyd, Donald W.** Oyster-like Permian Bivalvia: Am. Mus. Nat. History Bull., v. 143, art. 4, p. 217-282, illus., tables, 1970.

Some Permian bivalves of suborder Pteriina are considered in chronological sequence in an attempt to deduce evolutionary, probably iterative, trends by which several families achieved an oysterlike mode of life in late Paleozoic time and gave rise to true oysters (Ostreina), Spondylidae, and Anomiidae of the Mesozoic. The study is based chiefly on silicified fossils from reef and near-reef facies of Glass Mountains, Texas, and also from Wyoming, Arizona, and New Mexico. Fundamental characteristics in common suggest that Late Triassic gryphaeid oysters descended from the Pseudomonotidae, which also gave rise through another line to the Terquemiidae and the Spondylidae. New species of *Pseudomonotis*, *Prospondylus*, *Pegmavalvula*, *Palaeowaagia* (a terquemiid), and *Permanomia* (oldest certain anomiid), are described from Texas; the last three represent new genera. — VMJ

07889 **Noble, J. P. A.** Biofacies analysis, Cairn Formation of Miette Reef complex (Upper Devonian) Jasper National Park, Alberta: Bull. Canadian Petroleum Geology, v. 18, no. 4, p. 493-543, illus., 1970.

A reef complex in the Cairn Formation is exposed in the Rocky Mtn. Front Ranges near Jasper in which a number of biofacies can be recognized: unstable sand facies, reef facies, bulbous-irregular stromatoporoid facies, encrusting facies, algal facies, and basinal facies. Observations on reef morphology, reef-to-basin transitions, and fauna indicate that bathymetric and ecologic zonation across the reef and into the basin increased progressively throughout Carin time. Several changes in depth and environment of the reef surface took place. Four main phases are recognized: platform, transgressive, lagoonal, and mature. — *from* Author's abstract

07828 **Nordyke, Milo D.** On the use of nuclear explosives for stimulation of geothermal heat [abs.], *in* Symposium on engineering with nuclear explosives — Am. Nuclear Soc. and U.S. Atomic Energy Comm., Las Vegas, Nev., 1970, Proc., V. 2: Springfield, Va., Clearinghouse Federal Sci. and Tech. Inf., p. 1384-1385, illus., 1970.

Norris, A. W. *See* Stockwell, C. H. 07971

00403 **Norris, Stanley E.; Eagon, Herbert B., Jr.** Recharge characteristics of a watercourse aquifer system at Springfield, Ohio: Ground Water, v. 9, no. 1, p. 30-41, illus., 1971.

A study made of infiltration conditions in the alluvial-filled Mad River valley shows that most recharge to the 100-ft thick sand and gravel aquifer is from induced infiltration from the river. An attempt to measure infiltration losses directly was unsuccessful because the losses proved too small to measure accurately by ordinary stream gaging methods. Observation-well records over a four-year period show that groundwater levels follow an annual cycle. The rate of induced infiltration is not sufficient to prevent perennial dewatering of the aquifer beneath the stream bed. During the seven-month depletion period, average infiltration is estimated at 9 mgd, and during the five-month accretion period, at 12 mgd. — *from* Authors' abstract

00558 **Northrop, John; Morrison, Michael F.** Underwater sound signals from the Amchitka Island underground and underwater explosions: Jour. Geophys. Research, v. 76, no. 8, p. 1985-1992, illus., tables, 1971.

Underwater sound signals from the 1-MT Milrow underground explosion on Amchitka Island, and a 340-ton underwater explosion offshore of Amchitka, were recorded at several widely spaced Sofar depth hydrophones in the central Pacific. Signals from the underwater shot, which contained a bubble pulse frequency of 1.6 Hz, had a more rapid onset rate, higher peak pressure level, higher frequency content, and longer reverberations than those from the much larger Milrow shot. No aftershocks from the western Aleutian Island arc were detected for the 36-hr period monitored after Milrow. — Authors' abstract

00555 **Nur, Amos.** Effects of stress on velocity anisotropy in rocks with cracks: Jour. Geophys. Research, v. 76, no. 8, p. 2022-2034, illus., table, 1971.

The effective elastic compliance of rock containing cracks is evaluated from energy considerations. The compliance of rock depends on the compliance of the solid matrix, the directional distribution of the cracks, an 'inhomogeneity' interaction tensor, and the shape distribution of cracks, which are assumed to be shaped like pennies. The effective compliance is linearly elastic for small-amplitude elastic waves. Anisotropic crack distribution causes elastic anisotropy, with associated acoustic birefringence. Nonhydrostatic stress causes anisotropy, owing to anisotropic closure of cracks. Although velocities are uniquely determined from crack distribution, the distribution cannot be determined uniquely from velocities. These results agree with compressional velocities and crack distribution in Salisbury granite and with stress-induced compressional and shear velocity anisotropy in Barre granite. — *from* Author's abstract

00507 **Oakeshott, Gordon B.** The California State Geological Surveys: California Geology, v. 24, no. 2, p. 23-25, illus., 1971.

The history of geological exploration in California, beginning with the work of John C. Fremont in 1843-1844, is reviewed. The first California State Geological Survey was established in the early 1850's, and in 1961 it became the Division of Mines and Geology. Its administration and the various State Geologists are described. — EH

07962 **O'Brien, Neal R.** Clay flake orientation in flocculated illite — An electron microscope study: Maritime Sediments, v. 6, no. 2, p. 79-80, illus., 1970.

The fabric of uncompressed illite floccules formed under saline and salt-free conditions in the laboratory consists of an open porous network mainly consisting of randomly oriented domains or clusters of apparent stepped face-to-face flocculated flakes. The exact reasons for the parallel or sub-parallel orientation of the flakes are not known, although this orientation may indicate the importance of van der Waal attractive forces under the experimental conditions. The results of these experiments are in agreement with the gross fabric assumed by others to be present in honeycomb or cardhouse models of clay floccules; however, detailed study indicates more face-to-face flocculation than previously assumed. — Author's conclusions

O'Connor, J. T. *See* Orkild, Paul P. 08013

Offield, T. W. *See* Rowan, L. C. 07774

Ogner, G. *See* Schnitzer, M. 07854

00394 **Ohle, Ernest L.** The status of education in the field of mineral deposits [abs]: Econ. Geology, v. 66, no. 1, p. 208, 1971.

07818 **Olenin, V. B.; Sokolov, B. A.** Novyye perspektivy neftegazonosnosti akvatorii zemnogo shara [New perspectives on oil and gas in water areas of the Earth]: Akad. Nauk SSSR Doklady, v. 193, no. 6, p. 1364-1367, 1970.

The Gulf of Mexico is used to illustrate the theory that the formation of liquid and gaseous hydrocarbons increases when sedimentary deposits containing organic matter subside to depths of about 2 to 3 km and temperatures are between 65° and 80°, the zone of mesocatagenesis. Recent geological and geophysical data on the Gulf of Mexico prove that thick sedimentary deposits filled the Gulf in Mesozoic and Cenozoic times, were covered by a shallow sea by the end of the Triassic or in the Cretaceous, and subsided to a depth of 3 km below the sea. Analogous structures are found in other parts of the world. — EH

07687 **Oliver, Jack; Johnson, Tracy; Dorman, James.** Postglacial faulting and seismicity in New York and Quebec, *in* Symposium on recent crustal movements, Ottawa, Canada, 1969, Papers: Canadian Jour. Earth Sci., v. 7, no. 2, pt. 2, p. 579-590, illus., tables, 1970.

Evidence for postglacial bedrock faulting is common on outcrops of Paleozoic shales and slates from Hyde Park, New York, to St. Georges, Quebec. Faults tend to be in the plane of slaty cleavage with the south or east side upthrown in postglacial time. Displacement on a single fault is usually an inch or less but could be substantial if cumulative across a belt tens of miles wide. Whether faulting is associated with glacial loading or unloading, tectonic stresses, or possibly thermal changes, hydration, or a chemical process in the shales has not been resolved. Additional data is sought from other areas. If unaware of the regional pattern, casual observation would suggest heaving or slumping. Correlation between the pattern of observed faults and that of recent seismic activity is not highly convincing, but this could be because of inadequacies in both sets of data, so this question also remains open. — *from* Author's abstract

O'Neill, N. J. *See* Taylor, P. T. 00597

Onesti, Lawrence J. *See* McArthur, David S. 07958

08013 **Orkild, Paul P.; O'Connor, J. T.** Geologic map of the Topopah Spring quadrangle, Nye County, Nevada: U.S. Geol. Survey Geol. Quad. Map GQ-849, scale 1:24,000, sections, text, 1970.

The test is a description of map units, many of them igneous, and mostly Tertiary. — ESL

00498 **Orr, W. N.; Zaitzeff, J. B.** A new planktonic foraminiferal species from the California Pliocene: Jour. Foraminiferal Research, v. 1, no. 1, p. 17-19, illus., 1971.

Globigerina umbilicata, n.sp., is described from upper Pliocene marine sediments of the Rio Del Formation of the Wildcat Group, exposed near Eureka, Humboldt County, Calif. The new species is distinguished from *G. bulloides*, which occurs with it, by its less inflated and different number of chambers in the final whorl, and a distinct impressed suture on the spiral side. — VMJ

Ott, Jorg A. *See* Riedl, Rupert J. 07816

Ouryvaev, V. *See* Toebes, C. 07731

07745 **Overton, A.** Seismic refraction surveys, western Queen Elizabeth Islands and polar continental margin: Canadian Jour. Earth Sci., v. 7, no. 2, pt. 1, p. 346-365, illus., tables, 1970.

Two refraction profiles between Prince Patrick Island and Melville Island and one refraction profile extending 192 km into the ocean northwest of Brock Island are interpreted. The bottom of the basement complex has a compressional velocity of about 6.25 kmps and depths near 10 km. Velocity of P_n events is 8.18 kmps, and these were recorded near critical distances at one station. Average time-term of 3.67 sec represents an average crustal thickness of 35 km. Variation in crustal time-terms may be due to different thicknesses of low-velocity sediments rather than undulations on the crust-mantle surface. A negative correlation between crustal time-terms and Bouguer gravity values is due to varying proportions of low-velocity, low-density and high-velocity, high-density rocks within a few km of depth. — *from* Author's abstract

00552 **Ozima, Minoru; Ozima, Mituko.** Characteristic thermomagnetic curve in submarine basalts: Jour. Geophys. Research, v. 76, no. 8, p. 2051-2056, illus., table, 1971.

Thermomagnetic analyses at H = 3,000 oe were carried out for 24 submarine rocks dredged from 10 sites mostly from seamounts in the Pacific Ocean. Most of the samples, which are believed to be in situ, show an irreversible increase of both J_s and Curie temperature on heating both in air and in vacuum. This increase is explained as unmixing of the original titanomaghemite to magnetite and Ti-rich phases such as hemo-ilmenite and (or) pseudo-brookite. The characteristic irreversible change in the thermomagnetic curve is almost sufficient to discriminate uniquely submarine basalts, erupted and preserved in the sea, from those erupted in air. — Authors' abstract

Ozima, Mituko. *See* Ozima, Minoru. 00552

07773 **Page, Lincoln R.** Geologic analysis of the X-band radar mosaics of Massachusetts, *in* Earth Resources Aircraft Program, status review, V. 1: Houston, Tex., U.S. Natl. Aeronautics and Space Admin., Manned Spacecraft Center, p. 4-1—4-19, illus., [1970,].

The X-band radar mosaic of Massachusetts, at a scale of 1:500,000 presents an overall view of the geologic and geographic features of the state. Lineament patterns allow recognition of major structural features that can be related by geologists familiar with local areas to faults, joints, folds, and stratigraphy of bedrock, drumlins, fans, and channels of Pleistocene deposits. More refinement of the method is needed to obtain uniform quality of imagery, correctness of scale, and appropriate orientation of flight lines for maximum use in unknown terrain. — *from* Author's abstract

Palmberg, P. W. *See* Marcus, H. L. 00546

00473 **Pan, Cheh.** Fundamental statistical techniques for the analysis of earth tides: Seismol. Soc. America Bull., v. 61, no. 1, p. 203-215, illus., 1971.

Recent advances in instrumentation, digital computer technology and mathematical theory promote the error analysis of earth-tide data. Various statistical techniques developed and used in other fields are applicable in the study of earth tides, and the accuracy of the Earth's rigidity constants determined from the tides will be greatly improved with the help of these techniques. The fundamentals of the statistical techniques of autocorrelation, cross-correlation, convolution, statistical means, bandpass filtering, correlation coefficients, power spectra, coherency and equalization are described, and their principal applications in earth-tide analysis summarized. Examples of effective application of these techniques in elimination of errors in the tidal data are discussed. This work is an attempt to introduce statistical analysis into the earth-tide study. — *from* Author's abstract

07781 **Pan, Poh-Hsi; DeBremaecker, J. C.** Direct location of oil and gas by the seismic reflection method: Geophys. Prosp. [Netherlands], v. 18, supp., p. 712-727, illus., 1970.

The seismic velocity of sedimentary rocks is determined by the porosity, the velocity in the matrix and that in the fluid. The last two are known experimentally. The velocity can be measured from the surface. By applying the time average equation we can find the porosity. If the only difference at two points is the nature of the fluid in one layer, the ratio of the reflectivities of the layer at these points determines the nature of the fluid; this ratio is equal to the ratio of the amplitudes at these points. The size of the reservoir can then be found. The method can be applied to both oil exploration and production. It is more accurate in the latter case because more information is available than in the former case. The method is also more effective in developing discovered fields than the conventional method of relying only on the geological structural configurations. — Authors' abstract

Park, Richard A. *See* Gevirtz, Joel L. 00418

Parker, M. L. *See* Jones, F. W. 07814

07815 **Parker, M. L.; Meleskie, K. R.** Preparation of X-ray negatives of tree-ring specimens for dendrochronological analysis: Tree-Ring Bull., v. 30, nos. 1-4, p. 11-22, illus., 1970.

Techniques for producing X-ray negatives of dendrochronological specimens have been developed at the Geological Survey of Canada and the Nondestructive Testing Laboratory, Mines Branch. The radiographs provide tree-ring density data to supplement ring-width measurements for dating and climatic studies. New preparation techniques and X-ray methods are discussed, including preparation of 3/32-in thick cross sections of tree trunks, wood fragments, or charcoal, and a technique devised to expose very long tree-ring samples at the desired angle by in-motion radiography. The quality and quantity of tree-ring information is enhanced by the use of X-ray analysis, which is especially suitable for charcoal and very poorly preserved wood, such as archeological and interglacial specimens. — *from* Authors' abstract

08023 **Parsons, Myles L.** Groundwater thermal regime in a glacial complex: Water Resources Research, v. 6, no. 6, p. 1701-1720, illus., 1970.

Numerical simulation of the ground-water thermal regime in a glacial complex in the northern Ontario clay belt and numerical modeling of a hypothetical ground-water basin suggest that ground-water flow has a significant effect on the subsurface temperature field. Borehole temperature measurements reflect the hydrogeologic contrast between highly permeable eskerine deposits and adjacent less permeable clay and till strata. The eskerine ground water is several degrees warmer with lower spatial temperature variations than clay-till ground water. Numerical simulation of the temperature field indicates temperature variations are related to differences in thermal conductivities of the flow media, to variations in magnitude of the ground-water flux between esker and clay-till flow systems, and to spatial variations in the water table temperature. The latter probably reflects contrasting surface cover conditions between sandy eskerine and clay plain organic terrains. — *from* Author's abstract

08060 **Parsons, Myles L.** Groundwater movement in a glacial complex, Cochrane district, Ontario: Canadian Jour. Earth Sci., v. 7, no. 3, p. 869-883, illus., table, 1970.

The geologic framework comprises two eskerine sand bodies separated and partially covered by an extensive plain of lacustrine clay, all underlain by discontinuous till resting on fractured crystalline bedrock. Two ground-water environments are recognized — the elongate eskerine and the clay plain. Three types of ground-water flow systems are distinguished — local flow associated with the topographically high eskers, local flow centered around entrenched valleys in the clay plain, and regional flow with recharge in the flat interstream clay plain areas extending into the bedrock. — *from* Author's abstract

07670 **Pearce, T. H.** The analcite-bearing volcanic rocks of the Crowsnest Formation, Alberta: Canadian Jour. Earth Sci., v. 7, no. 1, p. 46-66, illus., tables, 1970.

The Lower Cretaceous Crowsnest Formation of the Crowsnest Pass area, Alberta, is predominantly trachytic, but some sodic, analcite-rich, rocks occur. It consists of bedded pyroclastic and epiclastic material with minor flows and dikes. Most of the volcanism appears to have been explosive in nature. Almost all the igneous material is porphyrytic; nearly all the phenocrysts are zoned, and evidence of resorption is common. Sanidine phenocrysts show evidence of repeated growth and solution with as many as 60 cycles per crystal. The primary, igneous, analcite phenocrysts of the analcite phonolites and blairmorites crystallized at depth, and were preserved by rapid vertical transport and quenching at the surface. In many cases, however, partial or complete decomposition of the crystals occurred, and thermal discoloration of the analcite can be reproduced in the laboratory. — Author's abstract

Pedro, G. *See* Brindley, G. W. 07847

08067 **Penner, E.** Thermal conductivity of frozen soils: Canadian Jour. Earth Sci., v. 7, no. 3, p. 982-987, illus., table, 1970.

Thermal conductivity measurements of two frozen soils, Leda clay and Sudbury silty clay, taken at temperatures between O° and -22°C by means of a thermal probe and a transient heat flow technique, compare favorably with estimates of thermal conductivity calculated by the DeVries method. Both measured and estimated values show a similar trend of increasing thermal conductivity as the temperature is lowered and the ice content grows. This increase is associated with the higher thermal conductivity of ice compared with that of water. — Author's abstract

00437 **Pequegnat, Willis E.; Bryant, William R.; Harris, John E.** Carboniferous sediments from Sigsbee Knolls, Gulf of Mexico: Am. Assoc. Petroleum Geologists Bull., v. 55, no. 1, p. 116-123, illus., 1971.

A violet siltstone was dredged from the Sigsbee Knolls in the southwest Gulf of Mexico. Determinations by K-Ar methods indicate that this rock is Carboniferous in age (318.9 ± 5 m.y.). The rock was analyzed by atomic absorption spectrometry, X-ray defraction, and electron microscopy. — SEF

07942 **Perkins, William Enfield.** Deep crustal reflections on land and at sea [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 31, no. 6, p. 3492B, 1970.

08022 **Perry, Douglas.** Early diagenesis of sediments and their interstitial fluids from the continental slope, northern Gulf of Mexico, *in* Exploration concepts for the Seventies: Gulf Coast Assoc. Geol. Socs. Trans., v. 20, p. 219-227, illus., tables, 1970.

A geochemical investigation was made on sediments and their interstitial waters in cores from the top 1,000 feet of sediment in water depths of 677 to 4,777 feet, from 36 sites on the northern Gulf of Mexico slope. Slope sediments have been compacted under normal overburden pressure, unless deposited very slowly or very rapidly. Away from salt domes, minor changes in incorporated sea water in the sediments have taken place with 1,000 feet of burial, suggesting mainly loss of water through compaction and loss of dissolved sulfate through bacterial action. High salinities near salt domes apparently are derived from waters moving upward past the salt in response to compaction, displacing the original interstitial water. These saline interstitial waters have characteristics similar to some deep oil field brines. Some subsurface waters in deep sediments probably have developed high salinities by contact with salt bodies and their cap rocks. — DBV

07943 **Perry, Edward Adams, Jr.** Burial diagenesis in Gulf Coast pelitic sediments [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 31, no. 6, p. 2385B, 1970.

Persoage, N. P. *See* Clark, R. H. 08078

Peterman, Z. E. *See* Turek, A. 08071

Petersen, F. L. *See* Cherry, J. T. 07908

Peterson, Frank L. *See* Adams, William M. 00404

08080 **Pettinger, Lawrence R.** Multiple resource inventory on space and high-altitude photography, *in* Earth Resources Aircraft Program, status review, 2d Ann., Houston, Tex., 1969 — V. 2, Agriculture, Forestry, and sensor studies: Houston, Tex., U.S. Natl. Aeronautics and Space Admin., Manned Spacecraft Center, p. 21-1—21-19, illus. [1970?].

The potential of high-altitude and spacecraft photographs for use in making land-use maps is evaluated on the basis of Apollo 9 space photographs and small-scale photographs from high altitude aircraft. It is shown that several different interpretation procedures can be integrated to obtain information from such photographs for agricultural, geologic, and hydrologic resources. The Phoenix area of Arizona is cited as an example. — VSN

00428 **Philcox, M. E.** Growth forms and role of colonial coelenterates in reefs of the Gower Formation (Silurian), Iowa: Jour. Paleontology, v. 45, no. 2, p. 338-346, illus., 1971.

Favositid corals of the Middle Silurian (Niagaran) Gower Formation of eastern Iowa, in association with stromatoporoids and crinoids, indicate reef environment characteristics. Radial growth of favositids makes domed surfaces, ordinarily from a flat base; concomitant sedimentation could restrict the growth surface, resulting in an obconical base, decreased angle of the cone reflecting increased sedimentation rate. Colonies were buried when the rate exceeded 2 cm/yr; irregularities reflect variation in rate. Sheet-form favositids seem to have lived in deeper quieter waters. The coelenterates did not build wave resistant frames, and were subordinate to crinoids as reef builders. — REG

07681 **Philpotts, A. R.** Igneous structures and mechanism of emplacement of Mount Johnson, a Monteregian intrusion, Quebec — Reply [to 1970 discussion by S. Bhattacharji and C. E. Nehru of 1968 paper]: Canadian Jour. Earth Sci., v. 7, no. 1, p. 195-197, illus., 1970.

For the paper under discussion, *see* ibid., v. 5, no. 5, p. 1131-1137, 1968; Abs. North American Geology, May 1969.

07842 **Phipps, Richard L.** The potential use of tree rings in hydrologic investigations in eastern North America with some botanical considerations: Water Resources Research, v. 6, no. 6, p. 1634-1640, illus., 1970.

Trees add a new growth layer, or ring, each year. Because growth is controlled in part by environment, analysis of tree rings can potentially yield information concerning past hydrologic (or other environmental) conditions. The present state of understanding of the relationship between tree growth and the hydrologic environment in the eastern United States does not yet allow detailed estimates of past environments from tree rings. It does appear though, that within the near future it will be possible to estimate certain hydrologic parameters in space (between gaging stations) from tree growth phenomena. For the present, however, examination of tree rings is most useful in hydrologic studies for dating of events. — Author's abstract

00519 **Pickett, T. E.; Kraft, J. C.; Smith, Kenneth.** Cretaceous burrows — Chesapeake and Delaware Canal, Delaware: Jour. Paleontology, v. 45, no. 2, p. 209-211, illus., 1971.

Morphologic evidence from the [Upper] Cretaceous rocks [Englishtown Formation] at the Chesapeake and Delaware Canal, Delaware, suggests that limonitic, nodulose tubes found there are burrows formed by a callianassid crustacean similar to the modern *Callianassa major* Say. Burrow distribution seems to be environmentally rather than stratigraphically controlled, and the presence of the burrow tubes is good evidence for mapping ancient shorelines. — Authors' abstract

Pierce, Kenneth L. *See* Smedes, Harry W. 07772

00436 **Pilkey, Orrin H.; MacIntyre, Ian G.; Uchupi, Elazar.** Shallow structures — Shelf edge of continental margin between Cape Hatteras and Cape Fear, North Carolina: Am. Assoc. Petroleum Geologists Bull., v. 55, no. 1, p. 110-115, illus., 1971.

Recent studies using continuous seismic profilers indicate that simple erosional processes alone are no longer acceptable in accounting for the origin of the edge of the continental shelf. The present study uses 30 lines of seismic profiles across the shelf edge between Cape Hatteras and Cape Fear, North Carolina. These studies substantiate the fact that the development of the edge of the shelf edge is the result of several processes. — SEF

00522 **Pinder, George F.; Sauer, Stanley P.** Numerical simulation of flood wave modification due to bank storage effects: Water Resources Research, v. 7, no. 1, p. 63-70, illus., 1971.

The modification of a flood wave due to bank storage effects can be calculated by using numerical methods. The dynamic equations describing one-dimensional open channel flow and the equation for two-dimensional transient ground-water flow are solved simultaneously, coupled by an expression for flow through the wetted perimeter of the channel. Numerical experiments indicate that flood waves may be modified considerably by bank storage, particularly in the lower segments of a long reach, and that the degree of modification is influenced markedly by the hydraulic conductivity of the aquifer. — Authors' abstract

07762 **Pippin, Lloyd.** Panhandle-Hugoton field, Texas-Oklahoma-Kansas — The first fifty years, *in* Geology of giant petroleum fields — Symposium, AAPG, 53d Ann. Mtg., Oklahoma City, Okla., 1968: Am. Assoc. Petroleum Geologists Mem. 14, p. 204-222, illus., 1970.

A detailed study of the geometry and an understanding of the mechanics of entrapment are essential in order to unravel the complexities of the Panhandle-Hugoton field. The reservoir rocks in the Panhandle-Hugoton field generally are considered to be Wolfcampian. Gas and oil appear to have migrated from Pennsylvanian marine shale in the Anadarko basin, through "granite wash" into the Panhandle field. In the Panhandle field, the trap is mainly structural, but in the Hugoton field, it is stratigraphic. A hydrodynamic component is present in both. Red Cave (Leonardian) reservoirs above the Wolfcamp and Pennsylvanian reservoirs below it usually are not considered part of the Panhandle-Hugoton field pay but, in the writer's opinion, could be so considered, because they appear to have had the same source, same initial pressure, and similar hydrocarbon-water contacts. — Author's abstract

00603 **Pittman, J. S.; Folk, Robert L.** Length-slow chalcedony after sulphate evaporite minerals in sedimentary rocks: Nature Phys. Sci., v. 230, no. 11, p. 64-65, 1971.

An examination of all chert thin sections in the University of Texas collection reveals that when a thin-section contains length-slow chalcedony, there probably is evidence of removed evaporites within the same hand specimen and less probably, it comes from a bed near an evaporite area and has been affected by water saturated with calcium sulfate. A chemical hypothesis is developed for the precipitation of silica as length-fast chalcedony in nonevaporite environments and as length-slow chalcedony in evaporite-prone environments. — DBV

Playford, Phillip E. *See* Wray, John L. 07890

00568 **Podosek, Frank A.** Neutron-activation potassium-argon dating of meteorites: Geochim. et Cosmochim. Acta, v. 35, no. 2, p. 157-173, illus., table, 1971.

Argon analyses are presented for stepwise heating of 9 specimens of 7 neutron-irradiated meteorites, and K-Ar ages calculated by the Ar-40/Ar-39 method. It is found that the chondrites Karoonda, St. Severin, and Allegan, and the aubrites Peña Blanca Spring and Bishopville all have identical K-Ar gas retention ages, 4.6 b.y. Bishopville, for which conflicting age results have been reported, has the same K-Ar age as the chondrites and Peña Blanca Spring. For these 5 meteorites there is no evidence for significant loss of radiogenic Ar-40, such as has been observed in hypersthene chondrites. A silicate inclusion from the hexahedrite El Taco seems to have experienced a heating event 3.4 b.y. ago. The results for separated chondrules and matrix of the unequilibrated chondritic Chainpur differ qualitively from those observed for other meteorites; the reasons are not clear. — DBV

00545 **Polegeg, Siegfried.** Prospektionserfahrungen in Ost-Grönland [Results of prospecting in East Greenland]: Montan Rundschau, v. 19, no. 1, p. 7-12, illus., 1971.

For a 2-month period in the summer of 1969 the author accompanied an expedition of the Danish mining company, Nordisk Mineselskab, to their concession area in East Greenland near Mesters Veg. However, the prospecting produced no results of commercial value. The geology of the area is reviewed and areas of potential interest are described. — EH

07973 **Poole, W. H.; Sanford, B. V.; Williams, H.; Kelley, D. G.** Geology of southeastern Canada, Chap. 6 *in* Geology and economic minerals of Canada: Canada Geol. Survey Econ. Geology Rept. 1 (5th edition), p. 227-304, illus., tables, 1970.

Southeastern Canada is composed of three major tectonic elements. The St. Lawrence Platform, bordering the Canadian Shield, is underlain by relatively thin orthoquartzite, carbonate and shale of early and middle Paleozoic age that lie unconformably on the crystalline rocks of the Shield. It is separated by crystalline rocks into southwestern Ontario, the Ottawa-Quebec Lowland, the Anticosti-Mingan Islands, coastal plain of western Newfoundland and southeastern coast of Labrador. The Appalachian Orogen, extending from Newfoundland southwestward, is divided into a fold belt produced by the Ordovician Taconic Orogen and by the Devonian Acadian Orogen, and an epi-engeosyncline of late Paleozoic strata partly deformed by the Maritime Disturbance. The Atlantic Continental Shelf is a slightly submerged area extending eastward to the edge of the continental block. The tectonic history of the area from Precambrian to Quaternary is described. — EH

07909 **Porter, Lawrence D.** Magnitude determination for large underground nuclear explosions, *in* Symposium on engineering with nuclear explosives — Am. Nuclear Soc. and U.S. Atomic Energy Comm., Las Vegas, Nev., 1970, Proc., V. 2: Springfield, Va., Clearinghouse Federal Sci. and Tech. Inf., p. 1118-1135, illus., tables, 1970.

A method is presented for determining local magnitudes for large underground nuclear explosions. The Gutenberg-Richter nomograph is applied to the peak amplitudes for 24 large underground explosions in Nevada. Amplitudes were measured at 18 California Wood-Anderson stations at 150-810 km from the explosion epicenter. Variation of individual station magnitudes and magnitude corrections and the variation of average and rms error estimates in magnitude determinations are examined with respect to distance, azimuth, and event location. The magnitude prediction capability of the Gutenberg-Richter nomograph is examined on the basis of these two criteria, and corrections are suggested. Azimuthal dependence of individual station magnitudes is investigated, and corrections for California stations are calculated. Statistical weighting schemes for two-component data are employed, and assumptions and limitations in use of peak amplitudes are discussed. — *from* Author's abstract

00486 **Powell, Benjamin N.** Petrology and chemistry of mesosiderites — [Pt.] 2, Silicate textures and compositions and metal-silicate relationships: Geochim. et Cosmochim. Acta, v. 35, no. 1, p. 5-34, illus., tables, 1971.

The petrology and chemistry of mesosiderites suggest that the genetic history of mesosiderites is very complex and includes a significant change in cooling environment. An evolutionary model is proposed which involves magmatic differentiation followed by brecciation, metal-silicate mixing, insulation by burial, metamorphism, and ultimate removal from the parent body. Mesosiderites are a distinct group and have no apparent affinities to other meteorite types aside from similarities and genetic relationship to Ca-rich achondrites. — DBV

00539 **Powell, Richard L.; Wells, Steve G.** The rediscovery of Crying Cave: Natl. Speleol. Soc. NSS News, v. 29, no. 3, p. 29-30, illus., 1971.

Crying Cave, on the Hatfield Farm, approximately six miles west of Bedford, Ind., is developed in limestones of the Blue River Group of Mississippian age, underlying a ridge near the eastern margin of the Crawford Upland. A geologic analysis of the cave is given. — EH

Pratt, P. F. *See* Hunsaker, V. E. 00408

07978 **Prest, V. K.** Quaternary geology of Canada, Chap. 12 *in* Geology and economic minerals of Canada: Canada Geol. Survey Econ. Geology Rept. 1 (5th edition), p. 675-764, illus., tables, 1970.

In the author's opinion the term Quaternary is interchangeable with Pleistocene as applied to Canada and includes the Recent, the period following dissipation of the last mainland ice sheet. Of the nearly 97 percent of Canada glaciated about one percent remains under glacial cover. All four major glaciations are represented; an interstade lasting about 20,000 yr, dividing Wisconsinan Glaciation, was terminated by major ice-frontal advance reaching a climax about 20,000 yr ago and disappearing from the mainland about 7,000 yr B.P. Time transgressive stratigraphic relations recognized in east-central Canada during late Quaternary probably apply to the whole Quaternary and all of Canada. Deposits that predate the climax of late Wisconsinan are discussed together, followed by an account of the last glaciation and deglaciation. Economic considerations of glacial deposits are also discussed. — EH

Quade, Jack. *See* Chapman, Peter. 07793

07987 **Rabchevsky, George A.** (compiler). Remote sensing of the Earth's surface: Jour. Remote Sensing, v. 1, no. 5, p. 14-17, 1970.

A short background paper is presented on the fundamentals of remote sensing of the Earth's surface, its value for many geological studies, and its application to hydrology and water resources, oceanography and marine resources, and geography, cartography, and cultural resources. A list of suggested further readings on the subject is included. — GDC

00431 **Rackley, Ruffin I.; Johnson, Robert L.** The geochemistry of uranium roll-front deposits with a case history from the Powder River basin [abs]: Econ. Geology, v. 66, no. 1, p. 202-203, 1971.

00483 **Rad, Ulrich von.** Comparison between "magnetic" and sedimentary fabric in graded and cross-laminated sand layers, southern California (with German, French, and Russian summ.): Geol. Rundschau, v. 60, no. 1, p. 331-354, illus., table, 1971.

Paleocurrent directions can be reconstructed by determining optically the preferred orientation of the longest grain axes of sediments, or by measuring the anisotropy of magnetic susceptibility. To check the applicability of both methods, the orientation of large- and small-scale sedimentary structures was compared with the "magnetic fabric" of some sand and silt layers in the Late Cretaceous Rosario Formation at La Jolla, Miocene Monterey and Topanga Formations in the Los Angeles basin, and Holocene submarine La Jolla fan. Most layers have a "primary-style" magnetic fabric suggesting moderately strong current conditions during deposition. As current-parallel orientation of the longest grain axes and maximum susceptibility axes prevails in deep-water sands, the magnetic method can be used for paleocurrent analysis. Characteristic differences in magnetic fabrics from different depositional environments may also provide clues to mechanisms of sediment transport. — DBV

Radforth, Norman W. *See* Brideaux, Wayne W. 07669

Radtke, Arthur S. *See* Roberts, Ralph J. 00369

00399 **Radtke, Arthur S.; Scheiner, Bernard J.** Cation exchange capacity and metal deposition, a suggestion — A reply [to discussion by R. L. Foster of article by Radtke and Scheiner, 1970]: Econ. Geology, v. 66, no. 1, Bateman issue, p. 201, 1971.

For original paper, *see* ibid., v. 65, no. 2, p. 87-102 (Abs. North American Geology, March 1971); discussion, ibid., p. 200-201. — WSW

Ragle, Richard H. *See* Bushnell, Vivian C. 07725

00560 **Rea, David K.; Erickson, Barrett H.** Bathymetric and magnetic profile along 143°W, Northeast Pacific Ocean: Jour. Geophys. Research, v. 76, no. 8, p. 1948-1953, illus., table, 1971.

A bathymetric and magnetic profile along 143°W from 29°N to 50°N crosses the Murray, Pioneer, Mendocino, Surveyor, and Sedna fracture zones at nearly right angles and serves to locate several of these features in an area where they previously were known only generally. A large leveed channel, probably Mukluk channel, lies atop a broad turbidite deposit between the Surveyor and Sedna fracture zones. — Authors' abstract

Rees, C. E. *See* Thode, H. G. 00487

Reynolds, M. A. *See* Kuroda, P. K. 00575

00534 **Rhodehamel, Edward C.; Kron, Veronica B.; Dougherty, Verda M.** (compilers). Bibliography of tritium studies related to hydrology through 1966: U.S. Geol. Survey Water-Supply Paper 1900, 174 p., 1971.

This report is a compilation of publications throughout the world that are related to the use and application of tritium (T or ^3H) in hydrology during the 25 years 1942 through 1966. The bibliography consists of a main list of references classified as to the principal subject matter of each item, and an auxiliary bibliography containing background knowledge about radioactivity, analytical techniques, and the various environments in which tritium exists. The introduction provides: (1) a brief discussion of the nature, sources, abundance, and uses of tritium that are applicable to hydrology; and (2) a description of the bibliography formats. — Authors' abstract

08032 **Rhodehamel, Edward C.** A hydrologic analysis of the New Jersey Pine Barrens region: New Jersey Div. Water Policy and Supply Water Resources Circ. 22, 35 p., illus., tables, 1970.

In this Atlantic Coastal Plain of south-central New Jersey, average annual precipitation is 45 in, and evapotranspiration losses total 2.41 bgd. In stream runoff, 2.14 bgd is base or ground-water runoff, variations of which per sq in of drainage basin are accounted for by distribution of precipitation and evapotranspiration, and by some ground-water flow bypassing local streams. Both ground and surface waters can have objectionable iron removed and acidic pH values adjusted to provide a suitable water supply for most purposes. High-yield wells located adjacent to downstream reaches of major streams can induce streamflow (largely ground-water discharge) to reenter the ground. Additional wells should be located further from streams, for use during long periods of low flow. Surface reservoirs are not as suitable in this region. — GDC

Richardson, J. W. *See* Webber, P. J. 07708

07816 **Riedl, Rupert J.; Ott, Jörg A.** A suction-corer to yield electric potentials in coastal sediment layers [with German abs.]: Senckenbergiana Maritima, v. 2, p. 67-83, illus., 1970.

The existence of a reduced biome underneath oxidized sediments, though observed by geologists, has until now been almost completely neglected by biologists. It is of

biological importance and of worldwide distribution, represented everywhere with the exception of narrow "high-energy windows." Its boundaries and basic properties can be tested particularly easily by means of electric potentials; a suction-corer was developed to facilitate collecting of electric data from undisturbed samples. — Authors' abstract

07826 **Rinehart, John S.** Origins of displacements caused by underground nuclear explosions, *in* Symposium on engineering with nuclear explosives — Am. Nuclear Soc. and U.S. Atomic Energy Comm., Las Vegas, Nev., 1970, Proc., V. 2: Springfield, Va., Clearinghouse Federal Sci. and Tech. Inf., p. 1095-1102, illus., 1970.

Elastic theory has been used to calculate the relative displacement that will occur between the two sides of a loose boundary when a plane wave strikes the boundary obliquely. The calculations suggest that the displacements produced along loose fractures and faults close in to the underground nuclear explosions are a direct consequence of reflection of the transient stress wave at this loose boundary. Quantitatively the results agree fairly well with the limited data that are available. — Author's abstract

00572 **Ringwood, A. E.** Core-mantle equilibrium — Comments on a paper by R. Brett [1971]: Geochim. et Cosmochim. Acta, v. 35, no. 2, p. 223-230, 1971.

Brett's arguments in the paper in question (ibid., p. 203-221) are critically reviewed. It is concluded that the abundances of Ni, Co, Cu, Au, and Pt in the upper mantle, the oxidation state of this region and the nature of the volatiles inferred to have been degassed from the upper mantle are not readily explained if the Earth has accreted from a well mixed reservoir of preexisting metal and silicate particles in the solar nebula which were equilibrated within the Earth prior to separation of the core. The data can be readily explained if it is assumed that the Earth accreted inhomogeneously in a state which was initially out of overall chemical equilibrium and that equilibrium, although approached, was not finally achieved during core-segregation. — *from* Author's abstract

Ritchie, W. D. *See* Barss, D. L. 07755

07868 **Ritchot, Gilles.** La cartographie geomorphologique en noir et blanc [Geomorphologic cartography in black and white]: Cahiers Geographie Quebec, v. 14, no. 33, p. 359-376, illus., 1970.

The author presents a legend and explanatory text for black and white geomorphologic maps, as well as examples of geomorphologic maps of the Montreal region at the scale of 1:25,000 based on the legend. — EH

00453 **Riva-Palacio, E.** *Planorbulina cretae* (Marsson) 1878, foraminifero incrustante del Neocretácico mexicano [. . . encrusting foraminifer from the Upper Cretaceous of Mexico (with English abs.)]: Rev. Española Micropaleontología, v. 3, no. 1, p. 61-66, illus., tables, 1971.

This species is reported from Upper Cretaceous lithological samples from localities in San Luis Potosí, Puebla, and Chiapas, in association with larger foraminifers, calcareous algae (*Amphiroa*), oncolites, and breccia of recrystallized mollusk and echinoderm fragments, indicating a reef or subreef facies. The species has been recorded from Campanian and Maestrichtian horizons in Cuba, western Europe, and Kuwait, and is considered a good index fossil for these horizons. — VMJ

Riva-Palacio, E. *See* Bonet, F. 07789

07884 **Roberts, George D.** History and applicability of geologic engineering: Eng. Geologist, v. 5, no. 1, p. 1-3, 1970.

This article, written a number of years ago for a symposium on engineering geology, is reprinted here to remind engineering geologists of their responsibilities and major objectives. Today the civil engineer has two main approaches for determining the

natural conditions at the site: the "Geological-and-Knowledge-of-Precedents" approach or the "Laboratory-Analysis-and-Numerical" approach. When engineers came to depend on the numerical approach alone, there was a coincident rise in construction failures. The geological engineer should be briefed on the proposed construction and make a field reconnaissance of the site. Then he should prepare a program of subsurface investigation based on his predictions, whose accuracy should constantly be checked as the study proceeds, and boring starts. Plotting cross sections may be useful. Excavations and foundation should be checked by a competent observer. — ESL

00369 **Roberts, Ralph J.; Radtke, Arthur S.; Coats, R. R.** Gold-bearing deposits in north-central Nevada and southwestern Idaho, *with* a section on Periods of plutonism in north-central Nevada *by* Miles L. Silberman; Edwin H. McKee: Econ. Geology, v. 66, no. 1, Bateman issue, p. 14-33, illus., tables, 1971.

Deposits belong to three principal groups, formed during five principal metallogenic epochs: early Mesozoic, late Mesozoic, early Tertiary, late Tertiary. Replacement deposits (mostly first four epochs) are zonally arranged around intrusive centers, with central pyrometasomatic deposits, outer base-metal and associated gold and silver deposits, and peripheral gold deposits. Disseminated deposits, thought to belong mostly to the fourth epoch, are characterized by low-temperature assemblages, perhaps akin to and above or outward from replacement deposits; they are associated with the Roberts Mountains thrust. Vein deposits are classified by host rock affinities: pre-Tertiary and granitic rocks, or Tertiary volcanic rocks; each group is further subdivided according to mineralogy and temperature. — WSW

Robertson, W. A. *See* Irving, E. 07702

08024 **Robinson, Gray S.** Change of the bathymetric distribution of the genus *Cyclammina*, *in* Exploration concepts for the Seventies: Gulf Coast Assoc. Geol. Socs. Trans., v. 20, p. 201-209, illus., 1970.

Disparities between ancient and modern occurrences of *Cyclammina* spp., both in abundance and in the nature of the associated fauna, indicate that the bathymetric distribution of the genus *Cyclammina* in the Gulf of Mexico has changed with time. An examination of Gulf Coast fossil assemblages reveals that this distribution became more restricted during the late Pliocene, with normal occurrences in the younger sediments being limited to upper bathyal and deeper zones. In the older section, the distribution extended into the neritic environment. This change was accompanied by a marked decrease in the relative and absolute abundance of *Cyclammina* spp. in the younger sediments. — Author's abstract

00474 **Rochette, Jean-Claude; Cailleux, André.** Dépôts nivéo-éoliens annuels à Poste-de-la-Baleine, Nouveau-Québec [Annual niveo-eolian deposits at Poste-de-la-Baleine (Great Whale), New Quebec (with English and Russian abs.)]: Rev. Géographie Montréal, v. 25, no. 1, p. 35-41, illus., 1971.

On the east shore of Hudson Bay, near the mouth of Great Whale River, mixed deposits of wind-driven sand and snow were observed in mid-June 1969. The lower layers were of consolidated snow, rarely with interlayered sand beds; the surface layers were of sand 1 to 20 cm thick. These deposits are located near deflation areas, most commonly in hollows, at the foot of slopes, or along the bay shore. The surface is uneven, usually forming sharp cones 10-30 cm high where the sand is thin, and rounded hillocks where the sand is thicker than 1 cm; these are most commonly spaced about 40-100 cm apart in groups. The sand layer on the hillocks is fissured, having conformed to the microrelief which was accentuated by the unequal rate of snow melting. Deforestation and trail-building may have enhanced deflation and formation of these deposits, but some occur in places where human agency seems excluded. — VMJ

07904 **Rockaway, John D., Jr.; Lutzen, Edwin E.** Engineering geology of the Creve Coeur quadrangle, St. Louis County, Missouri: Missouri Geol. Survey and Water Resources Eng. Geology Ser., no. 2, 19 p., illus., 1970.

The physical properties of soil and bedrock, geologic relations, and topographic features in this quadrangle were studied as a basis for interpreting general engineering characteristics. Map units have been delineated to represent specific engineering geologic conditions. The extent that geologic environment would influence or control land-use planning has been noted by a three-level rating system based on degree of anticipated severity. The most significant problems are associated with the Pennsylvanian sequence of shales, sandstones, and limestones covered by thick deposits of windblown silt, and are subject to slope failure and erosion problems. Additional problems were found where limestone bedrock has only a thin cover. These areas are characterized by irregular bedrock surface, sinkhole development, and soil creep. Soil and bedrock characteristics are significant factors in land-use planning. — *from* Authors' abstract

07824 **Rodean, Howard C.** Explosion-produced ground motion — Technical summary with respect to seismic hazards, *in* Symposium on engineering with nuclear explosives — Am. Nuclear Soc. and U.S. Atomic Energy Comm., Las Vegas, Nev., 1970, Proc., V. 2: Springfield, Va., Clearinghouse Federal Sci. and Tech. Inf., p. 1024-1050, illus., 1970.

Experimental and theoretical technical knowledge of how underground nuclear explosions produce seismic motion that may be a hazard at distances in tens of kilometers is summarized. Effects of explosion yield and rock properties on the ground motion are described in detail, and some consideration is given to the relation between ground motion and damage criteria. The problem of seismic motion pertinent to property damage is complicated because the damage-producing part of the wave train does not appear to be the first arrival but some subsequent portion. Thus, prediction of ground motion for seismic damage assessment is based on extrapolation of past experience and not upon calculations from first principles of mechanics. — *from* Author's abstract

07867 **Rodgers, John.** The tectonics of the Appalachians: New York, Wiley — Interscience, 271 p., illus., maps, 1970.

The geology of the Appalachians from Newfoundland to Alabama is treated comprehensively from a detailed study of the literature and the author's encyclopedic first-hand knowledge of the region. — JWC

00375 **Roedder, Edwin.** Fluid inclusion studies on the porphyry-type ore deposits at Bingham, Utah, Butte, Montana, and Climax, Colorado: Econ. Geology, v. 66, no. 1, Bateman issue, p. 98-120, illus., tables, 1971.

Study of primary and secondary fluid inclusions included use of freezing, heating, and crushing microscope stages. Fluids range from highly saline in central Cu-Mo core of Bingham deposit to nearly fresh water. Quartz-molybdenite-chalcopyrite veins from core yield temperatures of 640°-725°C. Samples from peripheral deposits were in the range 294°-330°C. There is abundant evidence of intermittent boiling. Densities of hydrothermal fluids ranging from 0.1-0.3 gm/cm^3 (steam inclusions) to 1.3 gm/cm (highly saline) could cause strong hydraulic pressure gradients and complex circulation patterns. More saline fluids are believed to be truly magmatic. Uniformity of secondary inclusions in thin individual planes and marked variation from plane to plane indicate repeated and thorough fracturing. Ranges of temperature composition, and density in samples from Butte, Climax, and Arizona were similar but smaller. — WSW

Rogers, G. C. *See* Milne, W. G. 07688

Rose, E. R. *See* Land, A. H. 07972

08008 **Rose, E. R.; Sanford, B. V.; Hacquebard, P. A.** Economic minerals of southeastern Canada, Chap. 7 *in* Geology and economic minerals of Canada: Canada Geol. Survey Econ. Geology Rept. 1 (5th edition), p. 305-364, illus., tables, 1970.

The mineral industry of southeastern Canada produced metals, a variety of industrial minerals, structural materials and fuels totaling 18 percent of the value of Canada's

mineral output in 1966. Structural materials and industrial minerals exceeded metals in value and asbestos was the most valuable product. Mineral deposits are noticeably associated with igneous rocks. More than 500 deposits occur in the serpentine belt of the Eastern Townships, Notre Dame Mts. of Gaspé Peninsula, central mineral belts of New Brunswick and Newfoundland, and in roof rocks of the Devonian granite in Nova Scotia. Asbestos, chromium, and nickel deposits are associated with ultrabasic and basic rocks, and gold, molybdenum, antimony, bismuth, tin and tungsten deposits with granitic rocks. The mineral deposits and mines and the formations containing them are described, broken down into metalliferous deposits, industrial mineral deposits and fuels, and accompanied by distribution maps and maps of individual deposits and mines. — EH

07944 **Rose, William Ingersoll, Jr.** The geology of the Santiaguito volcanic dome, Guatemala [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 31, no. 6, p. 3485B, 1970.

Rosenberg, P. E. *See* MacChesney, J. B. 08038

00527 **Ross, Sylvia H.** How a geologist finds water: Ground Water Age, v. 5, no. 5, p. 18-23, illus., 1971.

The author, a Wyoming State ground-water geologist, shows how a scientist finds water, as compared with a water witch or dowser. Using examples from her home area, Wyoming, she explains how she finds water, where she gets her information, how she works with drillers, how much it costs, and where to find a geologist. — ESL

07785 **Roth, Peter Hans.** Oligocene calcareous nannoplankton biostratigraphy (with German summ.): Eclogae Geol. Helvetiae, v. 63, no. 3, p. 799-881, illus., 1970.

The calcareous nannoplankton in ten Oligocene sections on both sides of the Atlantic is studied. Seven nannoplankton zones and ten biostratigraphic datum levels are used to correlate the sections. Correlations of nannoplankton zones and planktonic foraminiferal zones of various authors and the biostratigraphic extent of the classical European and U.S. Gulf coast stages are presented. Three new genera (*Cepekiella*, *Discoturbella*, *Holodiscolithus*) and 29 new species are described. — *from* Author's abstract

07902 **Rothwell, G. W.; Eggert, D. A.** A *Conostoma* with a tentacular sarcotesta from the Upper Pennsylvanian of Illinois: Bot. Gaz., v. 131, no. 4, p. 359-366, illus., 1970.

Conostoma villosum is a new species of lagenostomalean seed from coal balls in the Mattoon Formation at Berryville, Ill. The body of the seed is ovoid with rounded chalaza and a tapering apex flattened at the summit, circular in transverse section of the chalazal and midregions, becoming four-angled at the apex; abundant radiating tentaclelike sarcotestal appendages about 0.7 mm long, varying in form from uniseriate to multiseriate, increase the overall dimensions of the seed to about 6.0 mm long, 4.2 mm diam. Features of the nucellus and pollen-receiving structures correspond to those in other species of the genus; several grains of pollen or prepollen in the micropyle and pollen chambers are of two types, referable to *Vesicaspora* and *Punctatisporites*. Zonation of the integument into endo-, sclero-, and sarcotesta is more clearly evident in this species than in any other lagenostomalean ovule. — *from* Authors' abstract

07821 **Rousell, D. H.** Geology of the Iskwasum Lake area (east half), The Pas mining district, Manitoba: Manitoba Dept. Mines and Nat. Resources Mines Br. Pub. 66-3, 26 p., illus., tables, geol. map, 1970.

The map area lies within the Flin Flon-Snow Lake volcanic-sedimentary belt in the Churchill structural province. The southern part is underlain by flat-lying Ordovician dolomitic limestones above Precambrian rocks and the northern part by rocks of Precambrian age, both exposed extensively. Cliffs of Ordovician limestone rise as much as 60 feet above lake level. Glacial deposits are rather thin. The oldest Precambrian rocks comprise a sequence of interbedded volcanic flows, pyroclastic and sedi-

mentary rocks, the former intruded by metagabbro. Mafic and aplitic dikes and quartz veins are the youngest Precambrian rocks. Rocks possess a secondary foliation, generally parallel to and occasionally cutting across the primary layering. Joints, faults, and shear zones are common and cut all Precambrian rocks including mafic dikes. — EH

07774 **Rowan, L. C.; Offield, T. W.; Watson, Kenneth; Watson, R. D.; Cannon, P. J.** Thermal infrared investigations, Mill Creek area, Oklahoma, *in* Earth Resources Aircraft Program, status review, V. 1: Houston, Tex., U.S. Natl. Aeronautics and Space Admin., Manned Spacecraft Center, p. 5-1—5-25, illus., [1970,].

Thermal-infrared images obtained on flights over Tishomingo anticline and South Flank near Mill Creek in the Arbuckle Mts., Okla., were used to study possibilities of identifying some common rock types from their diagnostic reflection and emission characteristics, and to evaluate usefulness of infrared images in structural geologic investigations. The areas flown are underlain by folded and faulted Paleozoic dolomite, limestone, sandstone, shale, and Precambrian granite. The predawn image is the most useful in distinguishing rock types. The thermal contrast of dolomite and limestone is sufficient to distinguish the rock types and facies changes between them. Daytime images display much stratigraphic and structural detail, but fault or fracture zones are best displayed in the predawn image. — *from* Authors' abstract

07945 **Rowland, Tommy Lee.** Lithostratigraphy and carbonate petrology of the Morrow Formation (Pennsylvanian), Braggs-Cookson area, northeastern Oklahoma [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 31, no. 6, p. 3486B, 1970.

07737 **Rubin, Bruce.** Uranium roll front zonation in the southern Powder River basin, Wyoming: Earth Sci. Bull., v. 3, no. 4, p. 5-12, illus., 1970.

The ore-bearing continental Wasatch Formation consists of interbedded sand, silt, and shale. The author describes the nature of the sandstone and the radiometric characteristics of each zone of the "roll front" of the formation, in sequence from unaltered to most altered. Recognition of these zones in an ore region can contribute to the effectiveness of drilling, prevent overdrilling, and lower the cost of uranium production. — EH

Ruch, R. R. *See* Kennedy, E. Joyce. 00586

00601 **Ruch, R. R.; Gluskoter, Harold J.; Kennedy, E. Joyce.** Mercury content of Illinois coals: Illinois Geol. Survey Environmental Geology Note 43, 15 p., illus., tables, 1971.

Fifty-five raw coal samples from 10 coal seams in Illinois have a mean mercury concentration of 0.18 ppm and a mode between 0.10 and 0.12 ppm. Eleven coal samples from other states have concentrations within the same range as Illinois coals, or slightly lower. The neutron activation method used for determinations has a sensitivity of about 0.01 ppm and a precision of about ± 20 percent. Three coal samples were individually separated into specific gravity fractions in the laboratory, and all exhibited a mercury reduction of at least 50 percent in the lightest coal fraction and a concentration of mercury in the heaviest fraction. A more detailed study of a single coal sample suggests that a significant part of the mercury is associated with the pyrite in the coal, and the remainder (perhaps up to 50 percent) is in organic association. — *from* Authors' abstract

07985 **Rueff, Serge.** Wellhead geology — Its development and prospects: Canadian Petroleum, v. 11, no. 11, p. 42-44, 46, 1970.

The well-site geologist must not only record the geologic section of a well but also be manager while it is being drilled, together with the drilling engineer. With instantaneous and accurate knowledge of lithologic formations and nature of formation fluids and their pressure at each depth, the well-site geologist gives advice on the type of drilling and its details, mud characteristics, and casing depths. In a position to reduce the coring, testing, and geophysical logging to a minimum, he contributes to success

of the well and helps cut its cost. Various equipment available for geological logging, basic purpose and use of each instrument, and value of the composite and gas logs are described briefly. With improved recorders, treatment of cuttings, and automatic data processing, geological well-site personnel will be reduced to a single technician; geologists, in the computer center, deal with several wells simultaneously. — GDC

07709 **Ruffman, Alan; Woodside, John.** The Odd-twins magnetic anomaly and its possible relationship to the Humber Arm Klippe of western Newfoundland, Canada [with French abs.]: Canadian Jour. Earth Sci., v. 7, no. 2, pt. 1, p. 326-337, illus., 1970.

A distinctive twin-peaked magnetic anomaly known as Odd-twins magnetic anomaly has been traced for a distance of 65 km parallel to the coast of western Newfoundland about 10 km offshore. The magnetic anomaly is associated with a bathymetric high in some areas. It is interpreted as having been produced by two parallel basic dikes (or sills) dipping 30-40° W. Such dikes would be near the base of the Long Point Formation and may delineate the western boundary of the Humber Arm Klippe. — Authors' abstract

08044 **Ruhe, Robert V.** Soils, paleosols, and environment, *in* Pleistocene and recent environments of the central Great Plains: Kansas Univ. Dept. Geology Spec. Pub. 3, p. 37-52, illus., tables, 1970.

Certain features of environment may be read from the properties of paleosols if comparison is made to land-surface soils that are somewhat better understood in relation to environment. The present rigorous semiarid regime of the Central Plains dates from Brady time 11,400 to 9,100 years ago. The prairie in Iowa began 7000 to 8000 years ago. In pre-Brady time to the beginning of Wisconsin time, the climate in general was cooler and relatively more moist. Coniferous forest dominated Iowa to the Missouri River Valley in the southwestern corner of the state 24,500 years ago. The limits of extension of such vegetation westward on the plains is unknown. The forested Sangamon landscape was 175 to 350 miles northwest and southwest of present humid southern and northern forest and woodland zones. Sangamon Soil zones were displaced as much as 100 miles west of land-surface soil-analogue zones. Sangamon climates were more moist and may have been warmer than those of today. — *from* Author's abstract

07779 **Rummel, F.; Fairhurst, C.** Determination of the post-failure behavior of brittle rock using a servo-controlled testing machine (with German and French summ.): Rock Mechanics. v. 2, no. 4, p. 189-204, illus., 1970.

The use of the servo-controlled testing machine to control fracture when a rock specimen is deformed beyond its peak strength is described. The energy release is controlled by a high frequency electronic servo-control system acting in combination with a hydraulic system of very short response time. The control causes the excess energy to be withdrawn before it can be released into the disintegrating specimen, by removing pressurized fluid from the hydraulic system. The condition for controlled fracture is determined by the ability of the hydraulic loading system to unload rapidly; this may be expressed in terms of "dynamic stiffness" of the hydraulic system. For sufficiently small deformation rates and short servo-control response times the fracture process can be controlled. Some results obtained in studying the post-failure behavior of Tennessee Marble under uni-axial and bi-axial compression using the new system are presented. — *from* Authors' abstract

07677 **Russell, Dale A.** A skeletal reconstruction of *Leptoceratops gracilis* from the upper Edmonton Formation (Cretaceous) of Alberta: Canadian Jour. Earth Sci., v. 7, no. 1, p. 181-184, illus., 1970.

A skeletal reconstruction of the small protoceratopsian dinosaur *Leptoceratops gracilis* from the latest Cretaceous of Alberta is presented. *Leptoceratops* has a greater number of presacral vertebrae than in other known protoceratopsids, and the presacral vertebral count is recognized to be somewhat variable in ceratopsids as well. Psittacosaurids, protoceratopsids, and ceratopsids represent distinct lineages of the small general group of ornithischian dinosaurs. — Author's abstract

08061 **Rust, Brian R.; Coakley, John P.** Physico-chemical characteristics and postglacial desalination of Stanwell-Fletcher Lake, Arctic Canada: Canadian Jour. Earth Sci., v. 7, no. 3, p. 900-911, illus., tables, 1970.

Stanwell-Fletcher Lake basin formed during the Pleistocene by glacial scouring of soft sediments in a graben. As ice retreated, the basin filled with sea water and became a fiord. Subsequent isostatic uplift raised the marine shorelines to 150 m above the present sea level; the uplift curve indicates emergence of the fiord sill and termination of estuarine conditions about 3500 yr ago. Tidal influx persisted for about 1100 years before the lacustrine phase started. Comparisons with modern fjords and coastal meromictic lakes suggests that most of the salt left the lake during the lacustrine phase. The mechanism was probably entrainment of salt water into a deep fresh-water current flowing over the chemocline due to the convective summer circulation. — *from* Authors' abstract

00468 **Rybicki, Kacper.** The elastic residual field of a very long strike-slip fault in the presence of a discontinuity: Seismol. Soc. America Bull., v. 61, no. 1, p. 79-92, illus., 1971.

On the basis of dislocation theory, formulas for the elastic residual field of a long strike-slip fault in a half-space with a vertical and horizontal discontinuity are given. The obtained results are applied to the 1966 Parkfield-Cholame earthquake. There is good agreement between the calculated residual stress field and the distribution of aftershocks. The influence of an underlying layer on the residual-surface displacements and strains of a long, vertical strike-slip fault located in the surface layer was found. Both displacements and strains diminish faster as a function of distance from a fault in the presence of a more rigid underlying layer. The computed results show that the dislocation model of a fault in a homogeneous half-space can be inadequate in many cases. — Author's abstract

Rydell, H. S. *See* Bonatti, Enrico. 00570

07946 **Sachs, Jules B.** Calcareous nannofossils of the Aftonian shale, Louisiana continental shelf [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 31, no. 6, p. 3486B, 1970.

07787 **Saito, Tsunemasa; Hillman, Norman S.; Janal, Martin J.** The Brooks F. Ellis and Angelina R. Messina Catalogue of Foraminifera, Supplement for 1970, No. 1: New York, Am. Mus. Nat. History Spec. Pub., [782] p., illus., 1970.

This loose-leaf supplement contains 434 units new to the Catalogue: 36 genera or subgenera, one illustrated; and 398 species or subspecies (varieties), all illustrated except four that were previously or otherwise illustrated. Additions and corrections to previously published units are also included; these are concerned with lectotype designations, emendations, homonymy, new names, new depository information, and nomenclature. A bibliography of publications used in preparation consists of 66 titles. — *from* Authors' introduction

Sakamoto, K. *See* Kuroda, P. K. 00575

Salisbury, John W. *See* Hunt, Graham R. 00412

Sammis, Charles. *See* Anderson, Don L. 00538

07791 **Sánchez Z., J.; Villamar V., M.** Procedimiento de laboratorio para la separacion y cuantificación de las arcillas [Laboratory procedures for separation and quantification of clays]: Inst. Mexicano Petroleo Rev., v. 2, no. 4, p. 76-81, tables, 1970.

Laboratory procedures for separation and quantification of clays are outlined in a chart and described. Samples of various mixtures of materials are analyzed. — EH

Sanford, B. V. *See* Stockwell, C. H. 07971

Sanford, B. V. *See* Poole, W. H. 07973

Sanford, B. V. *See* Rose, E. R. 08008

00521 **Sangster, D. F.** Geological significance of stratabound sulphide deposits [with French abs.]: Geol. Assoc. Canada Proc., v. 23, p. 69-72, 1971.

The recognition of the possibility that stratabound ores are coeval with their host rocks and thus products of normal sedimentologic, volcanologic, or diagenetic processes has resulted in application of established principles of stratigraphy, sedimentology, volcanology, and geomorphology to ore genesis. It has also led to modifications and, in some instances, to rejection of the Lindgren school of hydrothermal origin of certain stratabound ores. Examples are cited to show how other earth science disciplines could find challenge in and contribute to study of stratabound sulfide ores. These deposits contain data which bear upon concepts of global geochemistry, earth history, primordial atmosphere, basin analysis, and petrochemistry. — VSN

00456 **Sargent, K. A.; Stewart, J. H.** Geologic map of the Specter Range NW quadrangle, Nye County, Nevada: U.S. Geol. Survey Geol. Quad. Map GQ-884, scale 1:24,000, sections, 1971.

00477 **Sarma, D. Gupta; Maru, V. M.** A study of some effects of a conducting host rock with a new modelling apparatus: Geophysics, v. 36, no. 1, p. 166-183, illus., tables, 1971.

An instrument is described which uses a new sampling technique to study the electromagnetic induction effects in a laboratory scale model representing conductors in the presence of host rock. It is found that the presence of a conducting host rock may substantially enhance the observed EM anomaly if the introduction of the target in the host rock alters the geometry of induced current paths. If this geometry is unaltered, a simple screening effect involving a reduction and phase rotation of the anomalous field occurs. — DBV

00425 **Satterfield, Ira R.** Conodonts and stratigraphy of the Girardeau Limestone (Ordovician) of southeast Missouri and southwest Illinois: Jour. Paleontology, v. 45, no. 2, p. 265-273, illus., table, 1971.

The physical stratigraphy and the conodont fauna of the Girardeau Limestone indicate a very late Ordovician age for the formation, which is transitional with the underlying Orchard Creek Shale and separated by a distinct unconformity from the overlying Edgewood Formation and Sexton Creek Limestone. The 31 conodont specimens recovered (28 from the type section at Cape Rock, Mo.) are assigned to six genera; six identifiable species, including *Prioniodus girardeauensis*, n.sp., are described and illustrated, and, in addition, one specimen of *Spathognathodus* may represent a new species. — JWH

Satyanarayana, K. V. S. *See* Krishna Murti, G. S. R. 08027

Sauer, Stanley P. *See* Pinder, George F. 00522

00559 **Savage, J. C.** A theory of creep waves propagating along a transform fault: Jour. Geophys. Research, v. 76, no. 8, p. 1954-1966, illus., 1971.

Movements of crustal blocks can be described in terms of edge dislocations flowing along a transform fault; dislocations are created at oceanic ridges and absorbed at oceanic trenches, but along the transform fault they are conserved. Total creep strain rate across the transform fault zone at any point will be proportional to q, the flow if dislocations past that point. A simple physical model suggests that q is governed by a kinematic wave equation. Kinematic wave propagation is characterized by amplitude dispersion that leads to formation of propagating shock waves (abrupt changes in creep rate). Arrival of these shock waves (presumably connected with high earthquake hazard) might be forecast in much the same way as flood crests on river systems. Very large earthquakes along the transform-fault system bounding the west coast of North America exhibit a migration pattern suggesting kinematic shock propagation. — *from* Author's abstract

07747 **Schaeffer, R. M.; Schwarz, E. J.** The Mid-Atlantic Ridge near 45° N. — [Pt.] 9, Thermomagnetics of dredged samples of igneous rocks: Canadian Jour. Earth Sci., v. 7, no. 2, pt. 1, p. 268-273, illus., table, 1970.

In basalt dredged from the Mid-Atlantic Ridge near 45° N., the Curie point and cell edge of original ferromagnetic constituents indicate the presence of Fe to Ti ratios of about 4.6. During heating to 550°C, the Curie point and saturation magnetization increased gradually while the cell edge decreased, suggesting oxidation of titanomagnetite to titanomaghemite. Above 600°C, a Curie point at -20°C was observed while saturation magnetization decreased as a result of exsolution of titanium-rich phase and transition of maghemite to hematite. Increase in Curie point with distance from the ridge suggests natural oxidation. Consequently, part of the original TRM has been replaced by CRM components which cancelled out one another as they were acquired in periods of different geomagnetic polarity. This decay of TRM explains the decreasing intensity of magnetic anomalies with distance from the axis. — *from* Authors' abstract

Scheiner, Bernard J. *See* Radtke, Arthur S. 00399

00494 **Schicht, Richard J.; Moench, Allen F.** Future demands on ground water in northeastern Illinois: Ground Water, v. 9, no. 2, p. 21-28, illus., tables, 1971.

Future water demands were estimated for each 10-yr interval from 1980 to 2020 for areas in the Chicago region dependent upon ground water as a source of supply. Demands were compared with ground-water availability to define water deficient areas. Two approaches were considered in developing the ground-water resource. The first approach limits ground-water withdrawals to the maximum rate of natural groundwater recharge that can be induced by pumping. The second approach allows withdrawals to exceed natural recharge. When limiting ground-water withdrawals to recharge a large part of the region will require importation of water by as early as 1980. With proper pumpage distribution it is conceivable that there is sufficient water than can be withdrawn in excess of natural recharge to meet demands through the year 2020. — Authors' abstract

Schmitt, R. A. *See* Borchardt, G. A. 07851

07854 **Schnitzer, M.; Ogner, G.** The occurrence of fatty acids in fulvic acid, a soil humic fraction: Israel Jour. Chemistry, v. 8, no. 3, p. 505-512, illus., 1970.

Only 10 percent of the total fatty acids, ranging C-14 to C-36, could be extracted by organic solvents from untreated fulvic acid. The remaining 90 percent was extractable only after methylation and adsorption on neutral aluminum oxide. Reduction of hydrogen bonding by methylation was related to release of fatty acids by the fulvic acid. Ninety-five percent of the acids isolated were saturated; the remaining were unsaturated and branched cyclic. Results suggested two origins for the fatty acids: microbiologic for C-14 to C-26, and plants for C-27 to C-36. Weight distribution plots of fatty acids and n-alkanes extracted from fulvic acid showed an an inverse concentration relationship between the two components with identical carbon numbers. Data reported here suggest that fulvic acid may act as a vehicle for mobilization, transport, and immobilization of water-insoluble organic compounds, some of which may be serious pollutants. — *from* Authors' abstract

07903 **Schock, R. N.** Dynamic elastic moduli of rocks under pressure, *in* Symposium on engineering with nuclear explosives — Am. Nuclear Soc. and U.S. Atomic Energy Comm., Las Vegas, Nev., 1970, Proc., V. 1: Springfield, Va., Clearinghouse Federal Sci. and Tech. Inf., p. 110-126, illus., 1970.

Elastic moduli are determined as a function of confining pressure to 10 kb on rocks in which Plowshare shots are to be fired. The theoretical treatment of small strains in an elastic medium relates the propagation velocity of compressional and shear waves to elastic moduli. Velocity measurements can provide, as unique code input data, the rigidity modulus, Poisson's ratio, and shear wave velocity, as well as checks on independent determinations of other moduli. Data obtained on a variety of rock types are presented and analyzed, and are discussed in terms of relationship to moduli mea-

sured by static methods as well as the effect of anisotropy, porosity, and fractures. — *from* Author's abstract

00422 **Schopf, Thomas J. M.; Farmanfarmaian, A.; Gooch James L.** Oxygen consumption rates and their paleontologic significance: Jour. Paleontology, v. 45, no. 2, p. 247-252, 1971.

The proposed correlation between respiratory rate and extinction rate, as developed by McAlester (1970), is untenable in its present form because of inherent difficulties in interpreting the available data on animal metabolism. Insufficient consideration was given to physiological bases of variation in metabolism, including effects of temperature, size, amount of skeletal material, season of collection, state of nutrition, reproduction, activity, and specific conditions of laboratory measurements. The chief correlation of rates of oxygen consumption is with organism size, degree of overt activity, and organizational complexity, but patterns are complex and individual cases must be considered on their own merits. — *from* Authors' abstract

Schrijver, K. *See* Martignole, J. 07876

08051 **Schultz, C. Bertrand; Martin, Larry D.** Quaternary mammalian sequence in the central Great Plains, *in* Pleistocene and recent environments of the central Great Plains: Kansas Univ. Dept. Geology Spec. Pub. 3, p. 341-353, illus., table, 1970.

Recent recovery of small vertebrate fossils from important Quaternary localities in Nebraska, where large species previously had been collected in abundance, have provided supplementary evidence concerning the stratigraphic sequence in various phylogenetic lines of mammals. Abundant remains of fish, amphibians, reptiles, and birds are associated with mammalian bones and teeth, thus assisting in environmental interpretations. An increasing number of early, middle, and late Pleistocene as well as Holocene vertebrate localities provide information for a mammalian sequence for the entire Quaternary of the Central Great Plains of North America. New evidence concerning evolution of bison and mammoths is summarized. Three new geologic names are proposed: Gothenburg Member of the upper unit of Loveland Formation, and Buzzard's Roost Paleosol Complex and Ingham Paleosol for upper and lower buried soil layers in the Loveland. — *from* Authors' abstract

Schwalb, Howard R. *See* McGrain, Preston. 07743

Schwarz, E. J. *See* Symons, D. T. A. 07676

Schwarz, E. J. *See* Schaeffer, R. M. 07747

07751 **Schwerdtner, W. M.** Hornblende lineations in Trout Lake area, Lac la Ronge map sheet, Saskatchewan: Canadian Jour. Earth Sci., v. 7, no. 3, p. 884-899, illus., tables, 1970.

Most rocks exposed in Trout Lake area are severely deformed migmatitic gneisses; hornblende-bearing layers or lenses are found throughout the entire area. Within cylindrical buckling folds and boudinage structures, orientation of hornblende lineations is related to local directions of megascopic finite strain parallel to layering for the main period of tectonic flow. Throughout all medium-scale folds and boudinage structures, hornblende lineations are parallel to M, the longest diameter of the local strain ellipsoid, and are also considered as indicators of M within large-scale folds. The areal pattern of M contains a diagonal belt across which plunge values tend to change "discontinuously." Because this belt coincides roughly with a major branch of Birch Rapids-Wepusko Bay fault zone, the angular "discontinuity" in the lineation map is attributed to "late" rotational faulting. – *from* Author's abstract

Scorgie, G. C. *See* Cameron, I. G. 07834

00585 **Secher, Karsten.** Geologi i Grönland – En geologisk vandreudstilling til Grönland [Geology in Greenland–A traveling geological exhibition of Greenland]: Grönland 1970, no. 1, p. 14-21, illus., 1971.

A traveling exhibition of the geology of Greenland, opened officially in Godthaab's Landsmuseet in September 1970, is a means of acquainting the population with work of Grönlands Geologiske Undersögelse and furthering interest in geological exploration. In the summer expeditions of 1969, Undersögelse employed 147 people, including geologists, technicians, and native assistants. The exhibits, so constructed that they can be transported with a minimum of difficulty, contain examples of minerals, rocks, various kinds of geological maps and charts, metals, exploration areas, and laboratory and associated activities. Explanations are given in both Danish and Greenlandic. — MCM

00517 **Seiglie, George A.; Bermúdez, Pedro J.** Foraminíferos de las bahías de Mayagüez y Anasco y de sus alrededores [Foraminifers of Mayaguez and Anasco bays and environs] – Pt. 1, *Ehrenbergina scamnicola* sp. nov. [with English abs.]: Rev. Española Micropaleontología, v. 3, no. 1, p. 67-70, illus., 1971.

The cassidulinid *Ehrenbergina scamnicola*, n.sp., was found in a sediment sample from a Pleistocene wave-cut terrace at a depth of 183 m off Mayaguez Bay, Puerto Rico; microspheric and megalospheric tests are characterized by short spines, numerous chambers, and triangular transverse section. The sample contained many fragments of deep-sea sponges and scleractinian corals; the associated foraminiferal fauna included 18 percent agglutinated species, also *Marginulina*, *Discorbinella*, *Hoeglundina*, and miliolids. The fact that no living specimens of the new species were found in the type sample, nor any living or empty tests in samples above and below it, is probably due to problems of microdistribution, as other species of the genus are commonly found living at similar depths. — VMJ

00518 **Seiglie, George A.** Distribution of foraminifers in the Cabo Rojo platform and their paleoecological significance [with Spanish abs.]: Rev. Española Micropaleontología, v. 3, no. 1, p. 5-34, illus., tables, 1971.

Benthonic foraminifers and their distribution were studied from 87 samples of Holocene sediments from the Cabo Rojo platform southwest of Puerto Rico. Five foraminiferal facies were determined: beach; back-reef bay; reef flat, divided into northern and southern subfacies; middle reef basin; reef talus and middle to outer shelf. Glauconitized foraminifers, characteristic of the middle and back reefs, were found in all facies but the reef flat; carbonized or pyritized foraminifers occur only in muddy sediments; none of these were found glauconitized, and no reef foraminifer was found carbonized or pyritized. No living foraminifers were observed in samples with high percentages of glauconitized foraminifers; *Archaias angulatus*, the most abundant glauconitized species, constitutes in part a relict fauna. A large percentage of foraminifers of the outer reef flat are recrystallized. Paleoecology is interpreted for some similar Tertiary bay facies in Puerto Rico. — VMJ

Senftle, Frank. *See* Vaz, J. Eduardo. 00553

Serson, P. H. *See* Haines, G. V. 07880

Shabad, Theodore. *See* Halbouty, Michel T. 07768

07850 **Shah, K. R.; Filby, R. H.; Haller, W. A.** Determination of trace elements in petroleum by neutron activation analysis — [Pt.] 1, Determination of Na, S, Cl, K, Ca, V, Mn, Cu, Ga and Br: Jour. Radioanal. Chemistry, v. 6, no. 1, p. 185-192, illus., tables, 1970.

Using thermal neutron activation and a large-volume high-resolution Ge(Li) γ-ray spectrometer, the feasibility of the determination of the concentrations of Na, S, Cl, K, Ca, V, Mn, Cu, Ga, and Br in crude oils has been demonstrated. This instrumental method, which requires neither a chemical separation technique nor pre-concentration or post-concentration of trace elements by ashing, eliminates many inherent errors associated with chemical determination. The method is sensitive, precise, and suitable for routine analysis. Fast neutron (n, p) and (n, α) reactions do not appreciably interfere, and where necessary corrections may be applied. Loss of volatile elements, e.g., chlorine and bromine, due to recoil during irradiation is negligible. — Authors' abstract

07717 **Sharma, Bijon; Geldart, L. P.; Gill, D. E.** Interpretation of gravity anomalies of dike-like bodies by Fourier transformation: Canadian Jour. Earth Sci., v. 7, no. 2, pt. 1, p. 512-516, illus., 1970.

An objective method is presented for interpreting the gravity anomalies of a dike using the Fourier transform of the observed gravity anomaly function. The amplitude spectrum of the transformed function contains information about the depth, inclination, and the thickness of the dike. The usefulness of the Fourier transform technique is illustrated by a detailed analysis of the gravity anomaly of a dike. — Authors' abstract

00588 **Sheets, Martin M.** Active surface faulting in the Houston area, Texas, 1971: Houston Geol. Soc. Bull., v. 13, no. 7, p. 24-33, illus., 1971.

The Houston area is one of very active tectonics as exhibited by many active surface faults, uplift, and subsidence which involve geologic structures and cause damage in the millions of dollars to engineering structures. Tectonic movements have been going on continuously throughout geologic time, are now active, and no doubt will continue in the future. Great damage has been done, primarily by active surface faulting, fortunately without a known tragedy. By the use of adequate geologic investigation and planning it should be possible to eliminate or minimize the resulting geologic hazards. One of the greatest needs is to alert the geologic profession and others and to enlist their cooperation. — *from* Author's abstract

Sherwood, H. G. *See* Anderson, C. D. 08070

07671 **Shewman, R. W.; Clark, L. A.** Pentlandite phase relations in the Fe-Ni-S system and notes on the monosulfide solid solution: Canadian Jour. Earth Sci., v. 7, no. 1, p. 67-85, illus., table, 1970.

A curve relating composition of synthetic pentlandite with interplanar spacing was determined experimentally as follows: $d_{115} = 1.9407 - 0.0023x + 0.0077x^2$, where x represents the iron to nickel weight ratio with d_{115} measured in A and the sulfur content is fixed at 33.0_5 wt percent. The iron, nickel, and sulfur solid solubility limits of pentlandite were determined. X-ray powder patterns of monosulfide solid solution heated at 500° and 400°C with a composition (wt percent) of 18.8 Fe, 43.8 Ni and 37.4 S showed a modulated structure. A solvus interrupts the monosulfide solid solution at 275 ± 10°C and the approximate composition in wt percent: Fe = $22._5$, Ni = 40, and S = $37._5$. The relatively common occurrence of the pyrite-pentlandite assemblage in nickel ores shows that the solid state reactions attendant upon cooling of these ores, proceed to temperatures at least below 200°C. — *from* Authors' abstract

07947 **Shilts, William Weimer.** Pleistocene geology of the Lac Mégantic region, southeastern Québec, Canada [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 31, no. 6, p. 3487B, 1970.

Shimp, N. F. *See* Kennedy, E. Joyce. 00586

Singh, B. R. *See* Agarwal, A. S. 00406

00435 **Skinner, Brian J.; Luce, Frederick D.** Stabilities and compositions of α-domeykite and algodonite: Econ. Geology, v. 66, no. 1, Bateman issue, p. 133-139, illus., tables, 1971.

α-domeykite, the cubic and low temperature form of Cu_3As, decomposes at 90 ± 10°C and approximately 1 atmosphere pressure to β-domeykite, composition $Cu_{2.7}As$ and algodonite, composition $Cu_{5.2}As$. Algodonite has a composition range from Cu_6As to $Cu_{5.2}As$, and a maximum temperature of stability of 300 ± 20°C at the composition Cu_6As. The presence of nearly pure masses of α-domeykite, such as those commonly observed in the Lake Superior copper district, is a clear indication of deposition below 90°C. — Authors' abstract

Slagle, S. E. *See* Gillespie, J. B. 07988

08083 **Slater, Philip N.; McKenney, Dean B.** Use of passband interference filters in multispectral photography, *in* Earth Resources Aircraft Program, status review, 2d Ann., Houston, Tex., 1969 — V. 2, Agriculture, Forestry, and sensor studies: Houston, Tex., U.S. Natl. Aeronautics and Space Admin., Manned Spacecraft Center, p. 28-1—28-18, illus., [1970,].

A new type of interference filter is described which can readily be designed for any central wavelength and any passband width. These filters provide sharper cutoffs and greater efficiency than conventional absorption filters, and total transmittance in the required passbands is 2 or 3 times greater, resulting in shorter exposure times and consequently about a twofold increase in spatial resolving power for early space multiband photography experiments. — *from* Authors' abstract

07961 **Slessor, D. K.** Benthonic foraminiferal ecology in Covehead Bay, Prince Edward Island — A preliminary study: Maritime Sediments, v. 6, no. 2, p. 48-64, illus., tables, 1970.

The fauna is cool-temperate to subarctic lagoonal, with no distinctive correlation between chemical parameters and foraminiferal distribution, because of the eurybathic nature of the fauna. Distribution of the living population is irregular and bears little relationship to that of the dead, which composes 80 percent of the total. The fauna is equally distributed between calcareous and arenaceous forms, with *Elphidium incertum* "complex" and *Eggerella advena* dominating. The environment within the bay is marginal for many species. Living to total ratios indicate that sedimentation rates are highest on silty or sandy substrates found in the intertidal zone, but these ratios are questionable. Lowest rates are in the tidal channel and offshore. No distinct biofacies were established within the bay. — *from* Author's conclusions

00495 **Sliter, William V.** Predation on benthic foraminifers: Jour. Foraminiferal Research, v. 1, no. 1, p. 20-28, illus., table, 1971.

Irregular, commonly oblique borings 3.7-14.3μ diam in tests of living and dead specimens of *Rosalina globularis* and rarely in dead specimens of *Bolivina doniezi* are attributed to predaceous free-living marine nematodes, which have been extracted from chambers of *R. globularis*. The foraminifers were from both natural and laboratory populations from Malaga Cove, south of Los Angeles, Calif. Preferred location of the boring seems to correspond to accessibility or living position of the prey and to ease of test penetration. Identical borings occur in Holocene (Galveston Bay, Tex.; Gulf of Mexico) and Upper Cretaceous (southern California) bathyal and neritic foraminifers. Round, multiple borings are also found in these specimens; they too may be caused by nematodes or polychaetes. The factor of predation can directly affect estimates of foraminiferal production and rates of sedimentation based on it. — VMJ

00565 **Slowey, J. Frank; Hood, Donald W.** Copper, manganese and zinc concentrations in Gulf of Mexico waters: Geochim. et Cosmochim. Acta, v. 35, no. 2, p. 121-138, illus., tables, 1971.

Neutron activation analysis techniques were used to determine the total concentration of Cu, Mn, and Zn in 84 samples obtained from 28 stations in the Gulf of Mexico. Wide ranges in concentration were found for all three elements both vertically and horizontally. Coastal values for manganese were found to be about a magnitude higher than those in the open sea. Cu and Zn were found often to have higher concentrations in the open sea than in coastal regions. Highest values in the open Gulf were usually found at the surface and at intermediate depths. The higher metal concentrations in the intermediate water appear to have their origin outside the Gulf of Mexico, and it is suggested that this enrichment results from release of trace metals by decomposing organisms. Deeper waters were found to be uniformly low in all three elements. — *from* Authors' abstract

07772 **Smedes, Harry W.; Pierce, Kenneth L.; Tanguary, Marc G.; Hoffer, Roger M.** Digital computer terrain mapping from multispectral data, . . . Yellowstone National Park, preliminary report, *in* Earth Resources Aircraft Program, status review, V. 1:

Houston, Tex., U.S. Natl. Aeronautics and Space Admin., Manned Spacecraft Center, p. 3-1—3-37, illus., tables, [1970,].

Digital computer processing of 12 wavelength bands of visible and reflective infrared scanner data has resulted in successful automatic computer mapping of eight terrain units in a Yellowstone National Park test site. The following terrain types were mapped with greater than 80 percent accuracy in a 12-sq-mi area with 1,800 feet of relief; bedrock exposures, talus, vegetated rock rubble, glacial kame terrace, glacial till, forest, bog, and water, and shadows; shadows of clouds and cliffs are depicted also. Studies were made also of effectiveness of the proposed Earth Resources Technology Satellite (ERTS) data channels as compared to the computer-selected best four channels in automatic recognition and mapping of the same terrain types based on simulation. Simulation map accuracies were only a few percent less than the best set of four channels. — *from* Authors' abstract

Smith, Gilbert E. *See* McGrain, Preston. 07743

08014 **Smith, J. Hiram.** Geologic map of the Wiborg quadrangle, McCreary County, Kentucky: U.S. Geol. Survey Geol. Quadrangle Map GQ-867, scale 1:24,000, sections and text, 1970.

The brief text gives the economic geology of the quadrangle. Coal is the only resource produced, and all production is from the Barren Fork bed. The map carries structure contours on the base of the Barren Fork. — ESL

Smith, Kenneth. *See* Pickett, T. E. 00519

Smith, R. *See* Windom, H. L. 00415

Smith, R. I. *See* Hemphill, C. R. 07756

00595 **Smith, Roberta K.** Late glacial Foraminifera from southeast Alaska and British Columbia and a world-wide high northern latitude shallow-water faunal province: Archives Sci., v. 23, no. 3, p. 675-701, illus., 1970 [1971].

Glaciomarine deposits of probable late Pleistocene age were sampled in the areas of Juneau, Alaska, and Lakelse, Queen Charlotte Islands, and Vancouver (mainland), British Columbia. A foraminiferal fauna of 105 species is dominated by *Elphidium clavatum*, with subdominants *E. frigidum s.l.*, *E. bartletti*, *Bucella frigida*, *B. Tenerrima*, *Islandiella teretis*, *Cassidulina barbara*, *Cibicides lobatulus*, *Nonionella auricula*, *Epistominella vitria*, *Fursenkoina fusiformis*, *Nonionellina labradorica*. Environmental analysis of the assemblages indicates differences in geographic restriction, salinity and temperature ranges for the areas, but the overall fauna is representative of a distinctive Quaternary foraminiferal province extending around the borders of the Arctic and northern North Pacific and North Atlantic Oceans in shallow, cold, marine and brackish waters. — VMJ

Smith, W. E. T. *See* Milne, W. G. 07688

Sokolov, B. A. *See* Olenin, V. B. 07818

00466 **Sorrells, G. G.; Crowley, J. B.; Veith, K. F.** Methods for computing ray paths in complex geological structures: Seismol. Soc. America Bull., v. 61, no. 1, p. 27-53, illus., 1971.

The mathematics for computing three-dimensional ray paths are developed for the case where the medium consists of a series of constant-velocity layers separated by planes or spherical interfaces. These relations are used to investigate the cause of the LONGSHOT traveltime anomaly. The results of the investigation suggest that the anomaly could be caused by the presence of a thick slab of high-velocity material which dips steeply beneath the Aleutian arc and terminates at a depth of 300 km. — Authors' abstract

07682 **Souther, J. G.** Volcanism and its relationship to recent crustal movements in the Canadian Cordillera, *in* Symposium on recent crustal movements, Ottawa, Canada, 1969, Papers: Canadian Jour. Earth Sci., v. 7, no. 2, pt. 2, p. 553-568, illus., 1970.

Compressive folding, thrusting, and transcurrent fault movement occurred in Late Tertiary and Recent times in southeastern Alaska and southern Yukon west of a line joining Denali, Queen Charlotte, and San Andreas fault systems. East of this line compressive deformation and transcurrent faulting ceased in the Canadian Cordillera by late Eocene or earlier, followed by crustal relaxation continuing to present, and accompanied by acid volcanism, block faulting, and high-level intrusion of granitic plutons and dike swarms. Explosive eruptions of early Tertiary were followed in late Miocene and Pliocene by outpourings of plateau basalt in central British Columbia and, in Pleistocene to Recent times, by construction of nearly 150 cinder cones and strato volcanoes. Two N-S belts of cones formed in response to E-W regional extension persistent in western Canadian Cordillera since late Eocene. — *from* Author's abstract

Sowers, G. M. *See* Friedman, M. 07715

08010 **Spall, Henry.** Palaeomagnetism of the Pikes Peak granite, Colorado: Royal Astron. Soc. Geophys. Jour., v. 21, no. 5, p. 427-440, illus., tables, 1970.

Samples collected from four sites over an area of 450 sq km in the 1020-1040 m.y.-old Pikes Peak granite, Colorado, are stable to thermal demagnetization above 500° C. A reliable Precambrian paleomagnetic pole is thus obtained at 179° W., 6° N. Alternating field demagnetization indicates that the granite has been partially remagnetized. Geological evidence suggests that this occurred during Laramide (early Tertiary) deformation of the Front Range — this is supported by the magnetic evidence from a fifth site. Titanomagnetite (moderately oxidized to ilmenite) is the main carrier of the primary NRM — hematite is responsible for the Laramide magnetization. — Author's summary

Spivak, J. *See* Moody, J. D. 07754

00525 **Springer, G.** The synthetic solid-solution series Bi_2S_3-$BiCuPbS_3$ (bismuthinite-aikinite) [with German summ.]: Neues Jahrb. Mineralogie Monatsh., no. 1, p. 19-24, illus., 1971.

Members of the Bismuthinite-aikinite solid solution series were synthesized using silica tubes as sample containers, and their stabilities were studied at temperatures above 300°C by quenching and DTA experimentation. Optical and X-ray examination showed complete solubility between bismuthinite and aikinite; the formation of superstructures observed with natural materials could not be detected. Aikinite was molten above 540°C and the liquidus temperatures increased with rising Bi contents to the melting point of bismuthinite at 765°C. — DBV

07912 **Staff Sediment Core Lab.** [J. E. Andrews, in charge]. Sediment core descriptions — Solomon Islands, 1968-1969, and Murray Fracture Zone, 1967: Hawaii Inst. Geophysics Data Rept., no. 16 (HIG-70-25), unpaginated, tables, 1970.

Data tabulated herein cover descriptions and physical properties of sediment cores collected in the period 1967-69 in the Pacific Ocean in the region of the Solomon Islands and Darwin Rise and along the central portion of the Murray Fracture Zone. — VSN

Stalker, A. MacS. *See* Churcher, C. S. 08072

07767 **Stanley, T. B., Jr.** Vicksburg fault zone, Texas, *in* Geology of giant petroleum fields — Symposium, AAPG, 53d Ann. Mtg., Oklahoma City, Okla., 1968: Am. Assoc. Petroleum Geologists Mem. 14, p. 301-308, illus., 1970.

Oil and gas fields, alined for almost 300 miles on downthrown side of down-to-basin Vicksburg faults in southern Texas and northeastern Mexico, represent a total ulti-

mate reserve of 3 billion bbl of oil and 20 trillion cu ft of gas. The deeply buried displacements are interpreted mostly from seismic records and well data, but are still not well understood. Hydrocarbon accumulation is largely due to downbending of downthrown blocks with dip reversal to form anticlinal closures, and faulting contemporaneous with deposition to form structural closures. Throughout the Vicksburg zone there is a history of post-Eocene movement which shifted progressively in places of multiple faults from one to another; widely separate data indicate possible earlier movement. Maximum activity was in Oligocene and early Miocene during deposition of Vicksburg and lower Frio terrigenous clastic sediments; soon after upper Frio deposition, faulting ceased. — GDC

07948 **Stapleton, Richard Pierce.** Ultrastructure of tests of some recent benthic hyaline foraminifera [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 31, no. 6, p. 3593B, 1970.

Stark, Philip H. *See* Forgotson, James M., Jr. 07837

00482 **Stauch, Friedrich.** Die Thule-Landbrücke als Wanderweg und Faunenscheide zwischen Atlantik und Skandik im Tertiör [The Thule land bridge as a migration path and faunal barrier between the Atlantic Ocean and the Norwegian Sea in the Tertiary (with English, French, and Russian summ.)]: Geol. Rundschau, v. 60, no. 1, p. 381-417, illus., 1971.

Faunal development in the Atlantic Ocean and Norwegian Sea followed separate courses during most of the Cenozoic, suggesting that they were completely separated. Differences between European, North Atlantic, and American land biota can be explained by assuming the early existence of a Davis Strait-Baffin Bay gulf. The Ellesmere-North Greenland land bridge operated since Oligocene at least, as a filter-barrier. The existence of a migration route over this link can be detected in Neogene times. Paleoclimatic implications are discussed. The Thule land bridge developed syngenetically with the opening of the ocean basin, and spanned the separating shores from the close of the Mesozoic until it broke up, probably as a result of a combination of offshore subsidences, widening of the sea floor, and erosion. — DBV

07716 **Stauffer, Mel R.** Deformation textures in tectonites: Canadian Jour. Earth Sci., v. 7, no. 2, pt. 1, p. 498-511, illus., table, 1970.

A variety of deformation textures may be present in low temperature tectonites that have not been modified extensively by post-deformational recrystallization. These include gross grain shape, granular, breccia, pull-apart, strain-shadow, goatee, and shear-step textures. A study of these textures will reveal the behavior of the rock during deformation, specifically: (a) whether deformation took place under conditions of high or low intergranular cohesion, and (b) the relative importance of crystallographic gliding and intergranular movement between grains. No study of deformed rocks is complete without a strain analysis. Strain analyses should include grain shapes, as well as description and interpretation of the various deformation textures. — Author's abstract

07980 **Stearn, C. W.; Mehrotra, P. N.** Lower and Middle Devonian stromatoporoids from northwestern Canada: Canada Geol. Survey Paper 70-13, 43 p., illus., 1970.

Stromatoporoids of 14 genera and 22 species are described from the Emsian, Eifelian, and Givetian carbonates of northern Yukon and northwestern Mackenzie; these faunas are quite different from the well-known Frasnian faunas of Alberta. The Gossage (Emsian-Eifelian) and Michelle (Emsian) formations, supposedly partly correlative, yielded three and two species respectively, poorly preserved, none in common with each other, but two also occurring in the overlying Ogilvie. The Ogilvie Formation (upper Eifelian-Givetian) yielded 16 species, including three known previously only from Frasnian rocks, and four new: *Tienodictyon jainaraini*, *Hammatostroma vermiforme*, *Stictostroma cavosite*, *Pseudoactinodictyon cranswickense*. The Hume Formation, partly correlative, yielded four species previously known from Eifelian to Frasnian rocks. — VMJ

07857 **Steenland, N. C.** Recent developments in aeromagnetic methods: Geoexploration, v. 8, nos. 3-4, p. 185-204, illus., 1970.

This paper attempts to present the state of aeromagnetic data processing and analysis from the perspective of its evolution since the introduction of the Gulf Airborne Fluxgate Magnetometer in 1948. It is concerned exclusively with aeromagnetic data applied to search for hydrocarbons in localized structures, but the content pertains to ground magnetic data, mineral exploration, to crustal or regional studies, and even to the 'new global tectonics.' Although high sensitivity magnetic instrumentation has been available for at least five years, data processing, including compilation and interpretation, has not kept abreast of this development and has hindered the efficient application of the method. — Author's abstract

07964 **Stehman, Charles F.** Eocene deep water sediment from the Northeast Providence Channel, Bahamas: Maritime Sediments, v. 6, no. 2, p. 65-67, illus., table, 1970.

Origin and age of the re-entrant channels incising the Bahama Banks are unknown because sediments are deposited at quite a high rate, and sampling techniques have not penetrated to sufficient depths to answer such questions. This report concerns discovery of a section of lower middle Eocene material. Stratigraphic positioning was based on foraminifera, and the complete planktonic foraminiferal fauna is listed. It is suggested that this section has lain undisturbed since deposition. It is overlain by about three meters of Pleistocene and Holocene sediments, resembling that from Tongue of the Ocean, and consisting of discontinuous sedimentary sequences. The Eocene is characterized by an increase in insoluble residue compared with younger sediments. — ESL

07832 **Stephens, D. R.; Lilley, E. M.** Loading-unloading pressure-volume curves for rocks, *in* Symposium on engineering with nuclear explosives — Am. Nuclear Soc. and U.S. Atomic Energy Comm., Las Vegas, Nev., 1970, Proc., V. 1: Springfield, Va., Clearinghouse Federal Sci. and Tech. Inf., p. 89-109, illus., tables, 1970.

A rapid and accurate method is described to obtain pressure-volume data to 40 kb at 25°C for rocks. Results may be related to *in situ* elastic properties of the rock and to other laboratory measurement of properties, such as ultrasonic experiments with pressure and Hugoniot determinations. Qualitative features of pressure-volume curves can be related to initial porosity of the rock. A porous rock is usually quite compressible at low pressures. If porosity is in the form of narrow cracks, cracks are closed at a pressure of about 3 to 6 kb, after which the rock is much less compressible. If porosity is in the form of spherical pores, it is not necessarily removed even at pressures of 40 kb, depending on rock strength, and the compressibility is higher at all pressures than for a similar rock containing no porosity. Data for water-saturated samples show phase transformation due to free water at about 10 and 22 kb. — *from* Authors' abstract

00542 **Stephens, J. D.** Microprobe applications in mineral exploration and development programmes: Minerals Sci. and Eng., v. 4, no. 1, p. 26-37, illus., 1971.

During mineral exploration, the microprobe may be used to illustrate element associations in a single mineral or mineral assemblage. Analysis of valuable mineral constituent may indicate the grade of concentrate obtainable, or the amount of a byproduct element recoverable by processing an ore. During the mine-development phase, the microprobe can be used to obtain valuable information about metal losses during beneficiation of ore. If a hydrometallurgic approach is used, the probe may be used to show how solutions contact a rock. It can also be used to identify the mineralogic nature of valuable elements lost in leached residues. Microprobe studies of three exploration problems and three development problems are described in detail. — *from* Author's abstract

07949 **Stevens, James Bowie.** Geology of the Castolon area, Big Bend National Park, Brewster County, Texas [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 31, no. 6, p. 3487B, 1970.

Stevens, R. D. *See* Wanless, R. K. 00448

00395 **Stevenson, William G.** Mineral exploration then and now [abs]: Econ. Geology, v. 66, no. 1, p. 209, 1971.

Stewart, D. H. *See* Burnham, J. B. 07827

Stewart, J. H. *See* Sargent, K. A. 00456

07900 **Stewart, Joseph W.; Hanan, Robert V.** Hydrologic factors affecting the utilization of land for sanitary landfills in northern Hillsborough County, Florida: Florida Bur. Geology Map Ser., no. 39, scale about 1 in to 1 mi, sections, text, 1970.

The hydrologic map shows drainage, sand and clay thickness, areas of artesian flow and sinkholes, location of public water supplies, and of sanitary landfill sites. Two smaller scale maps show soil permeability, and potentiometric surface and water table during a wet period. Relatively favorable environments for location of sanitary landfills include areas (1) where the top of the Floridan aquifer is more than 25 feet below land surface and overlain by relatively impermeable beds, (2) having adequate surface drainage, not subject to flooding, (3) beyond the zone of diversion of large ground-water withdrawals, (4) remote from streams connected with the Floridan aquifer, (5) having no history of sinkhole formation. The most favorable locations are in the eastern half of the county south of Hillsborough River. — ESL

08074 **Stewart, Joseph W.** Synoptic remote-sensing survey of lakes in west-central Florida, *in* Earth Resources Aircraft Program, status review, 2d Ann., Houston, Tex., 1969 — V. 3, Hydrology and oceanography: Houston, Tex., U.S. Natl. Aeronautics and Space Admin., Manned Spacecraft Center, p. 38-1-38-32, illus., [1970,].

The use of remote sensors to determine interrelations between lakes of different characteristics, their occurrence, and effects on hydrologic regimen of an area was tested over the west-central Gulf Coast of Florida. Thermal infrared imagery and natural and intrared color photography data provide a detailed synoptic record over a large area at a near-instantaneous time interval, and are useful for water storage inventories; determination of type, source, rate of water body eutrophication; delineation of vegetative zones; and for insight into subsurface drainage, such as sink drains and artesian springs. Infrared imagery identifies thermal anomalies from artesian flow, water circulation, and water depth. Infrared color photography is preferred to natural color as a vegetation indicator, delineation of shoreline boundaries, and qualitative evaluation of depth and turbidity. — VSN

00419 **Stitt, James H.** Repeating evolutionary pattern in Late Cambrian trilobite biomeres: Jour. Paleontology, v. 45, no. 2, p. 178-181, illus., 1971.

A four stage pattern of adaptive radiation is suggested for the Late Cambrian trilobite populations of the Pterocephaliid and Ptychaspid Biomeres [western interior U.S.]. Each stage is characterized by its internal composition and the stratigraphic ranges of the species involved. This interpretation appears to be compatible with previous speculation about biomeres. — Author's abstract

07861 **St-Julien, P.** (compiler). Orford-Sherbrooke area, Richmond, Sherbrooke, Shefford, Brome, Stanstead, and Compton Counties: Quebec Dept. Nat. Resources Map 1619, scale 1:50,000, 1970.

07971 **Stockwell, C. H.; McGlynn, J. C.; Emslie, R. F.; Sanford, B. V.; Norris, A. W.; Donaldson, J. A.; Fahrig, W. F.; Currie, K. L.** Geology of the Canadian Shield, Chap. 4 *in* Geology and economic minerals of Canada: Canada Geol. Survey Econ. Geology Rept. 1 (5th edition), p. 43-150, illus., tables, 1970.

The Canadian Shield, a region of Precambrian rocks, is surrounded, except on the northeast, by Phanerozoic sedimentary rocks which form a little-disturbed platform cover. Inliers of Precambrian rocks protrude through the cover and, in the bordering geosynclines, are involved in folding in several mountain belts. The rocks of the platform cover which may once have covered the Shield remain now only as the Hudson Platform, the Foxe Basin, and as erosional remnants and down-faulted blocks. The Shield, virtually stable since the end of Precambrian time, has been disturbed by

Phanerozoic faults in the south and on the borders of the Boothe Uplift. The geology of each structural province and subprovince of the Shield is described. The Precambrian orogenies and their K-Ar ages, the Precambrian time-stratification classification in relation to orogenies, and geophysical data are summarized. — EH

00547 **Stoll, Robert D.; Ewing, John; Bryan, George M.** Anomalous wave velocities in sediments containing gas hydrates: Jour. Geophys. Research, v. 76, no. 8, p. 2090-2094, illus., tables, 1971.

Natural gas and water combine to form an ice-like substance called a gas hydrate under certain conditions of temperature and pressure. These conditions appear to exist over large areas of the ocean bottom. An experiment is described in which artificially formed gas hydrate is shown to cause marked increase in acoustic wave velocity suggesting that anomalously high velocities observed *in situ* in gassy sediments may indicate the presence of such hydrates. — Authors' abstract

07898 **Stott, D. F.** Jurassic and Cretaceous rocks of Pine River region, British Columbia, *in* Peace River, Pine Pass, Yellowhead 1970 — Edmonton Geol. Soc. Field Conf., 12th, Guidebook: Edmonton, Alberta, Edmonton Geological Society, p. 58-83, illus., table, 1970.

Jurassic and Cretaceous rocks are a thick succession of marine shales and sandstones interbedded with continental coal-bearing strata totaling well over 20,000 feet. It is probable that a series of depositional troughs developed, with the axis of each successively younger one occurring farther east. Jurassic Fernie and basal Cretaceous Minnes strata crop out only in the Foothills. Bullhead strata occur along axes of major synclines, and in folds to the lower end of Peace River Canyon. Younger beds crop out eastward with the Lower Cretaceous Fort St. John beds appearing east of Crassier Creek in Pine River valley. The Upper Cretaceous Dunvegan is involved in folding along the eastern Foothills and extends into the Plains. The younger marine Smoky Group appears south of John Hart Highway along an escarpment. The overlying continental Wapiti strata form the bedrock surface of most of the Plains south of the highway. — ESL

Stott, D. F. *See* Douglas, R. J. W. 07974

Stott, D. F. *See* Little, H. W. 07975

00465 **Stromquist, Arvid A.; Choquette, Philip W.; Sundelius, Harold W.** Geologic map of the Denton quadrangle, central North Carolina: U.S. Geol. Survey Geol. Quad. Map GQ-872, scale 1:62,500, sections, text, 1971.

The text is a description of map units, many of them igneous, and mostly Ordovician. — ESL

07872 **Stumm, Erwin C.** Corals of the Traverse Group of Michigan — Pt. 13, Hexagonaria: Michigan Univ. Mus. Paleontology Contr., v. 23, no. 5, p. 81-91, illus., table, 1970.

Species of the colonial rugose coral genus *Hexagonaria* are among the most common corals in the Traverse Group. *H. anna* (Whitfield) occurs from Bell Shale into upper Ferron Point Formation; *H. percarinata* (Sloss) is common, and *H. cristata 00*(Rominger) is present in Gravel Point Formation. The new species *H. fusiformis* is confined to Genshaw Formation with one problematic specimen from Newton Creek Limestone and one possibly from Ferron Point Formation. Two new species *H. subcarinata* and *H. alpenensis* are common in Alpena Limestone. New species *H. attenuata* is present in Alpena Limestone, Four Mile Dam Formation, and Charlevoix Limestone, and new species *H. potterensis* in Potter Farm Formation and Thunder Bay Limestone. *H. profunda* (Hall), is known from one specimen in Petoskey Limestone. — *from* Author's abstract

Sundelius, Harold W. *See* Stromquist, Arvid A. 00465

07950 **Sutter, John Frederick.** Application of the K/Ar method to the dating of cataclastically deformed rocks [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 31, no. 6, p. 3487B-3488B, 1970.

07805 **Swinton, W. E.** The dinosaurs: London, George Allen and Unwin Ltd., 331 p., illus., tables, 1970.

The main purpose of this text is to give the descriptive paleontology of the dinosaurs to which is added the early history of discovery and recognition of remains, the story of international dinosaurian exploration, and the question of growth rates, individual age, evidence of accident and disease, and the problem of extinction. Details are given of the most important localities for finding dinosaur remains, as well as a list of principal collections throughout the world. The text has 14 chapters. — VSN

07813 **Swirsky, Lillian (compiler).** List of translations in the library of the Geological Survey of Canada, No. 1: Canada Geol. Survey Paper 70-62, 25 p., 1970.

This listing contains selected titles of translations requested by the scientific staff of the Geological Survey of Canada between 1967 and 1970. It is arranged by author, and bibliographic information included identifies the original document. Photocopies may be obtained. — VSN

Syers, J. K. *See* Henderson, J. H. 07853

08017 **Sykes, C. Ronald.** Mineral resources summary of the Buena Vista quadrangle, Tennessee: Nashville, Tenn., Tennessee Div. Geology, 6 p., tables, 1970.

This summary accompanies geologic map GM 10-NE by D. L. Brown. Sand is the only resource that has been mined. Potential resources are clay and heavy minerals. — ESL

07672 **Symons, D. T. A.** Paleomagnetism of the Nipissing diabase, Cobalt area, Ontario: Canadian Jour. Earth Sci., v. 7, no. 1, p. 86-90, illus., table, 1970.

At Cobalt the Nipissing diabase intrusive occurs as a 1000 ft (about 305m) thick undulating sheet exposed in a series of basin and arch structures from which 112 specimens were collected at 14 sites. Paleomagnetic analysis of the cleaned natural remanence directions from the 11 acceptable sites suggests that these structures are dominantly primary. Minor post-solidification compression associated with the NW-SE trending faults may have amplified the primary NE-SW axial trends of the structures. Significant folding adjacent to the faults does not appear probable. The origin of the narrow argentiferous veins is probably related to minor local differential movements of large blocks of diabase or to cooling-contraction of the sheet. A revised pole position of 91.9°E, 19.4°N (dp = 3.9°; dm = 6.5°) is given for the 2140 m.y. old Nipissing diabase. — Author's abstract

07676 **Symons, D. T. A.; Schwarz, E. J.** Paleointensity study of late Miocene igneous rocks from British Columbia, Canada: Canadian Jour. Earth Sci., v. 7, no. 1, p. 176-181, illus., tables, 1970.

Sixty-nine specimens from 49 late Miocene (10-15 m.y. ago) basaltic lava flows and 4 associated gabbroic intrusive plugs were studied to estimate paleointensity of the earth's magnetic field in south-central British Columbia. Paleointensity determination was based on comparison of decay of natural remanent magnetism intensity with that of an artificial thermoremanent magnetism (H = 0.35 Oe) in progressively higher alternating demagnetizing fields (peak: 800 Oe). Estimated average equatorial intensity for the late Miocene earth's field is 0.18 Oe ± 0.11. This agrees reasonably well with those from contemporaneous rocks from North America, Japan, and Iceland. Several low determinations with consistent, normal, or reversed remanence directions suggest intensity of the nondipole components of the late Miocene field must have been very small in the sampled area. — *from* Authors' abstract

Szabo, F. *See* Hemphill, C. R. 07756

Takagi, Robert S. *See* Berry, William B. N. 00581

07856 **Talwani, Manik.** Developments in navigation and measurement of gravity at sea: Geoexploration, v. 8, nos. 3-4, p. 151-183, illus., table, 1970.

This paper reviews recent developments in methods of navigation and of measurement of gravity. The U.S. Navy's satellite navigation method is described, and various systems for interpolating between satellite fixes are discussed. Cross-coupling and off-leveling errors for surface ship gravimeters are examined. The principles of operation of the recently developed vibrating string and force balance type gravimeters are described. — Author's abstract

Tanguary, Marc G. *See* Smedes, Harry W. 07772

07878 **Tank, R. W.; McNeely, L.** Clay minerals associated with the Precambrian Gowganda Formation of Ontario: Clay Minerals, v. 8, no. 4, p. 471-477, illus., table, 1970.

X-ray analyses indicate that chlorite, illite and mixed-layer chlorite-smectite are present in the $< 2\mu$ fraction of the Precambrian Gowganda Formation near Bruce Mines, Ontario. The mixed-layer material is restricted to the porous graywacke sandstones and is epigenetic in origin. The chlorite and illite are ubiquitous and may reflect high-grade diagenesis, low-grade metamorphism or a source rich in these minerals. — Authors' abstract

Tauxe, George W. *See* Yeh, William W-G. 00593

07897 **Taylor, G. C.; Bamber, E. W.** Paleozoic stratigraphy of Pine Pass, northeastern British Columbia, *in* Peace River, Pine Pass, Yellowhead 1970 — Edmonton Geol. Soc. Field Conf., 12th, Guidebook: Edmonton, Alberta, Edmonton Geological Society, p. 46-57, illus., table, 1970.

The Paleozoic succession of the Pine Pass area consists of shallow marine carbonates, sandstones, and shales of Cambrian, Ordovician, Devonian, early Carboniferous (Mississippian), and Permian age. Several major facies changes and unconformities occur within this sequence, which is intermediate in nature between those to the north and south, and is therefore important for the establishment of regional correlations between the Jasper area and the northern Rocky Mountains and Foothills. — Authors' abstract

00563 **Taylor, G. Jeffrey; Heymann, Dieter.** Postshock thermal histories of reheated chondrites: Jour. Geophys. Research, v. 76, no. 8, p. 1879-1893, illus., table, 1971.

Five chondrites were reheated by shock to residual temperatures ranging from 480°C up to about 1,200°C, corresponding to shock pressures of 0.5 to > 0.8 Mb. In two cases the metal was essentially homogenized by solid-state diffusion; in two others the metal-troilite assemblage was clearly melted. The P content of the metal phase was found to be substantially higher than in unreheated ordinary chondrites. It was concluded that P was reduced from calcium phosphate by carbon; reduction was made possible by stabilization either by dissolution in the metal phase or by formation of phosphides. Using the coefficients of Ni diffusion in the metal phase and the temperature-time dependence in the center of a semi-infinite slab of finite thickness, maximum depths at which these meteorites were buried after shock events were estimated; values range from less than one meter up to several hundred meters. — DBV

00598 **Taylor, G. Jeffrey; Heymann, Dieter.** The formation of clear taenite in ordinary chondrites: Geochim. et Cosmochim. Acta, v. 35, no. 2, p. 175-188, illus., tables, 1971.

The metallic phases in 6 bronzite and 6 hypersthene chondrites all contain zoned taenite. In bronzites only about 5 percent of the zoned taenite abuts on kamacite, whereas in hypersthenes, an average of over 20 percent abuts on kamacite. The compositions of centers of zoned taenite can be used to obtain cooling rates; 14 out of 18 ordinary chondrites have cooling rates between 1° and 10° C per m.y. All bronzite chondrites also contain clear taenite which nearly always borders on kamacite; clear

taenite is significantly less abundant in hypersthenes. The composition suggests that clear taenite formed in the temperature range 390°-340°C. Apparently it nucleated on kamacite when diffusion of Ni from kamacite to zoned taenite had become too sluggish to maintain equilibrium. This may explain why clear taenite is much more abundant in bronzites. — DBV

07951 **Taylor, G. Jeffrey.** Electron microprobe study of the metallic minerals in ordinary chondrites [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 31, no. 6, p. 3591B, 1970.

00492 **Taylor, O. James.** A shortcut for computing stream depletion by wells using analog or digital models: Ground Water, v. 9, no. 2, p. 9-11, illus., tables, 1971.

Theory indicates that the effect of a discharging well on a nearby stream is independent of the length of the reach. The theory was confirmed using a digital computer model of short and long reaches of a stream-aquifer system. Digital computations using short reaches of most stream-aquifer systems will give results comparable in accuracy to one of a long reach with considerably less effort and expense. — Author's abstract

00597 **Taylor, P. T.; Brennan, J. A.; O'Neill, N. J.** Variable seafloor spreading off Baja California: Nature, v. 229, no. 5284, p. 396-399, illus., table, 1971.

Sea-floor spreading rates off Baja California have been computed from residual magnetic profiles and the time scales of Heirtzler and others (1968) and Vine (1966). The results, which are tabulated, show that the spreading rate is not uniform (2.91 to 4.24 cm per yr), but varies as a function of latitude. An abrupt change in spreading rates at lat 28°45′ N. indicates two different ridge segments having different spreading rates, displaced by a transform fault. The nascent East Pacific Rise may have been in existence during the early Pliocene, and the North American continental plate did not override it until later. — DBV

Taylor, Thomas N. *See* Zimmerman, Roger P. 00485

Taylor, W. A. *See* Davis, C. E. 07869

07711 **Terasmae, J.; Anderson, T. W.** Hypsithermal range extension of white pine (*Pinus strobus* L.) in Quebec, Canada: Canadian Jour. Earth Sci., v. 7, no. 2, pt. 1, p. 406-413, illus., table, 1970.

Fossil wood, cones, and leaves of white pine (*Pinus strobus* L.) were discovered at Val St. Gilles, Quebec, some 60 miles north of the present distribution limit of this species. The fossils were buried under several feet of peat, and were dated at 5030 ± 130 (GSC-585) radiocarbon years before present. In the pollen diagram from this peat exposure a white pine pollen maximum coincides with the stratigraphic unit in which the fossil pine wood was found. This discovery indicates that white pine was growing well north of its present distribution limit during the Holocene hypsithermal interval, when climatic conditions were more favorable in this region than at present. — Authors' abstract

Terasmae, J. *See* Karrow, P. F. 07722

00487 **Thode, H. G.; Cragg, C. B.; Hulston, J. R.; Rees, C. E.** Sulphur isotope exchange between sulphur dioxide and hydrogen sulphide: Geochim. et Cosmochim. Acta, v. 35, no. 1, p. 35-45, illus., tables, 1971.

The variation with absolute temperature, T, of the sulfur isotope equilibrium constant, K, between sulfur dioxide and hydrogen sulfide has been measured and the results compared with theoretical calculations. In the temperature range 800°K to 1300°K the experimentally measured variation is $(K - 1) = (4540/T^2) - 0.0003$, while the theoretically calculated variation is $(k - 1) = (3650/T^2)$. These two estimates do not quite overlap within the assigned limits of error but theory and experiment agree to within less or about 1 percent in the temperature range studied. Thus geochemical

calculations involving this exchange reaction may be performed with confidence using either estimate for the isotope equilibrium constant. — Authors' abstract

Thomas, J. A. *See* Wright, H. E., Jr. 07732

Thompson, B. E. *See* Davis, C. E. 07869

Thompson, T. D. *See* Brindley, G. W. 07906

07952 **Thomson, Kenneth Clair.** Mineral deposits of the Deep Creek Mountains, Tooele and Juab Counties, Utah [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 31, no. 6, p. 3488B, 1970.

07976 **Thorsteinsson, R.; Tozer, E. T.** Geology of the Arctic Archipelago, Chap. 10 *in* Geology and economic minerals of Canada: Canada Geol. Survey Econ. Geology Rept. 1 (5th edition), p. 547-590, illus., 1970.

The Arctic Archipelago is underlain chiefly by rocks of Phanerozoic age. Rocks of all Paleozoic and Mesozoic systems and of Cenozoic age are present, chiefly sedimentary, but also some plutonic and volcanic rocks. Several intervals of Paleozoic orogeny and some Cenozoic deformation affected the area. Seven major geological provinces are described: Arctic Lowlands, Boothia Uplift, Franklinian Geosyncline, Sverdrup Basin, Prince Patrick Uplift, Arctic Coastal Plain and Arctic Continental Shelf. A chronological account of the sedimentary volcanic, plutonic, and tectonic events which took place in the area is given. — EH

Tilling, Robert I. *See* Greenland, L. Paul. 00526

Tipper, H. W. *See* Frebold, Hans. 07667

Tixier, M. *See* Elloy, R. 07901

00499 **Todd, Ruth.** Recent literature on the Foraminifera: Jour. Foraminiferal Research, v. 1, no. 1, p. 45-52, 1971.

One hundred twenty-four items are cited and briefly annotated. — VMJ

Todd, Terry. *See* Boore, David M. 00472

07731 **Toebes, C.; Ouryvaev, V.** (editors). Representative and experimental basins — An international guide for research and practice: Paris, UNESCO (Studies and reports in hydrology, no. 4), 348 p., illus., tables, 1970.

The six chapters of the text discuss the aims of publication and the purpose of representative and experimental basins; criteria for selecting sites and organizing basin networks; organization and planning of observations according to aims of the research being carried out on the basin; descriptions of observation methods and types of instruments to be used for study of the various parameters of the hydrological cycle; the wide range of methods for data processing, synthesis, and preparation for publication; and analysis techniques and interpretation of results. — GDC

07970 **Toombs, R. B.** The Canadian mineral industry, Chap. 3 *in* Geology and economic minerals of Canada: Canada Geol. Survey Econ. Geology Rept. 1 (5th edition), p. 31-42, illus., tables, 1970.

The Canadian mineral industry increased rapidly after World War II and should continue to accelerate. Data on production, consumption, and export are reviewed, and the historical background of the industry and its structure and capacity are outlined. Measured and indicated reserves of some minerals in 1956 and 1967 are tabulated, revealing that molybdenum, uranium, and sulfur have shown the largest increase except for crude oil and natural gas. Canada is the world's third-largest diversified mineral producer, with seven metals, asbestos, petroleum, and natural gas accounting for most of its exports in dollar value. It is the world's leading producer of nickel,

zinc, and asbestos and is deficient only in manganese, chromium, tin, bauxite and phosphate rock. Resource development and production problems are discussed. — EH

08066 **Toomey, Donald Francis; Mountjoy, Eric W.; MacKenzie, Warren S.** Upper Devonian (Frasnian) algae and foraminifera from the Ancient Wall carbonate complex, Jasper National Park, Alberta, Canada: Canadian Jour. Earth Sci., v. 7, no. 3, p. 946-981, illus., tables, 1970.

Strata of the Ancient Wall complex comprise two formations, each with two members. They are: the Cairn Formation with a lower Flume Member and an upper member, and the overlying Southesk Formation with a lower member and the upper Simla Member. A biota of 15 genera and 21 species is recorded. There are four genera and six species of algae, some spheres and borings, and eight genera 14 species of foraminifers. Calcareous foraminifers, dominantly parathuramminids, comprise about two-thirds of the total biota. This biota substantiates a shallow-water environment for both formations, with the packstones and grainstones, which occur more frequently in the Southesk Formation, indicative of more agitated and presumably shallower waters. — *from* Authors' abstract

08068 **Tóth, J.** Relation between electric analogue patterns of groundwater flow and accumulation of hydrocarbons: Canadian Jour. Earth Sci., v. 7, no. 3, p. 988-1007, illus., tables, 1970.

Theoretical considerations, experimental results, and practical observations all indicate that certain hydrocarbon accumulations are identifiably related to the presently prevailing pattern of ground-water flow. This, in turn, can be realistically approximated from the configuration of the water table and consists of topographically-controlled, hydraulically continuous, and regionally unconfined flow systems, modified in detail by the local heterogeneities of the geologic framework. — *from* Author's abstract

Towe, Kenneth M. *See* Gibson, Thomas G. 00515

07846 **Townsend, M. G.** On the dichroism of tourmaline: Jour. Physics and Chemistry Solids, v. 31, no. 11, p. 2481-2488, illus., table, 1970.

The dichroism of tourmaline arises partially from charge-transfer transitions within next-nearest neighbour cations through shared octahedral edges in the 001 layer. Similar structural features occur in the sheet silicates, and charge-transfer spectra in these structures are discussed. — Author's abstract

Tozer, E. T. *See* Thorsteinsson, R. 07976

07706 **Tremblay, L. P.** The significance of uranium in quartzite in the Beaverlodge area, Saskatchewan: Canadian Jour. Earth Sci., v. 7, no. 2, pt. 1, p. 280-305, illus., tables, 1970.

Quantitative spectrographic analyses for Cr, V, Cu, Ni, and Co of 219 specimens of the country rocks from the Beaverlodge area, Saskatchewan , and chemical analyses for U of 68 of those rock specimens and for Th of 38 of them have shown that positive relationships exist between the above elements and uranium in quartzite, and that quartzite may be the principal source of uranium in the uranium deposits. — Author's abstract

Truesdell, A. H. *See* White, D. E. 00374

Tu, H. Y. *See* Lynn, W. C. 00410

08071 **Turek, A.; Peterman, Z. E.** Rb-Sr contribution to the location of Churchill-Superior boundary in Manitoba: Canadian Jour. Earth Sci., v. 7, no. 3, p. 1017-1020, illus., table, 1970.

Eight whole-rock Rb-Sr age determinations on basement cores from the Hudson Bay Lowlands define an isochron of 1975 ± 45 m.y. ($A_{Rb} = 1.39 \times 10^{-11} y^{-1}$) with an initial Sr-87/Sr-86 0.7018 ± 0.0005. The indicated age is characteristic of the Churchill Province and on this basis would suggest that the boundary between the Churchill and Superior provinces is to the south of the drill hole location. A similar age, 1925 ± 105 m.y. with an initial Sr-87/Sr-86 0.7025 ± 0.0007, has been obtained on six whole-rock basement samples from the Minago River-Hargrave River area north of Lake Winnipeg. — Authors' abstract

07999 **Turk, L. J.** Hydrology in the urban environment, *in* Environmental geology — AGI short course lecture notes, Milwaukee, Wis., 1970: Washington, D. C., Am. Geol. Inst., 37 p., paged separately, illus., tables, 1970.

Hydrologic principles of the runoff cycle and flood frequency are discussed. The effects of urbanization on the hydrologic system are to increase unit yield, peak discharge, and sediment yield and to reduce lag time and recharge to ground water. In order to reduce risks and minimize problems in urban hydrology, it is necessary to institute floodplain zoning and corrective measures to reduce flood hazards. Geologists and geology teachers must educate laymen, lawmakers, and planners on the necessity of floodplain zoning. — EH

08002 **Turk, L. J.** Disposal of solid wastes — Acceptable practice or geological nightmare,, *in* Environmental geology — AGI short course lecture notes, Milwaukee, Wis., 1970: Washington, D. C., Am. Geol. Inst., 42 p., illus., tables, 1970.

The author reviews various types of solid waste disposal and their shortcomings, and discusses the role of sanitary landfill in preventing pollution of the air, soil, surface, and ground water. In planning a landfill site, it is important to evaluate the rock types in the site area for premeability and for such anomalous features as fracture zones and solution collapse features. Other variables are topography, depth of soil cover, and depth to water table or zone of saturation. The author gives examples of landfills in various geologic situation and describes the optimal situation. Once a fill is established monitoring should be constant. Various monitoring techniques are described. — EH

07953 **Tysdal, Russell Gene.** Geology of the north end of the Ruby Range, southwestern Montana [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 31, no. 6, p. 3488B-3489B, 1970.

Uchupi, Elazar. *See* Pilkey, Orrin H. 00436

Uchupi, Elazar. *See* Ballard, Robert D. 00502

U.S. Atomic Energy Commission. *See* American Nuclear Society. 07831

00334 **U.S. Geological Survey.** Aeromagnetic map of the Athol quadrangle, Worcester and Franklin Counties, Massachusetts: U.S. Geol. Survey Geophys. Inv. Map GP-736, scale 1:24,000, 1971.

00335 **U.S. Geological Survey.** Aeromagnetic map of the Templeton quadrangle, Worcester County, Massachusetts: U.S. Geol. Survey Geophys. Inv. Map GP-737, scale 1:24,000, 1971.

00336 **U.S. Geological Survey.** Aeromagnetic map of the Gardner quadrangle, Worcester County, Massachusetts: U.S. Geol. Survey Geophys. Inv. Map GP-738, scale 1:24,000, 1971.

00337 **U.S. Geological Survey.** Aeromagnetic map of the Fitchburg quadrangle, Worcester County, Massachusetts: U.S. Geol. Survey Geophys. Inv. Map GP-739, scale 1:24,000, 1971.

00338 **U.S. Geological Survey.** Aeromagnetic map of the Shirley quadrangle, Worcester and Middlesex Counties, Massachusetts: U.S. Geol. Survey Geophys. Inv. Map GP-740, scale 1:24,000, 1971.

00339 **U.S. Geological Survey.** Aeromagnetic map of the Ayer quadrangle, Middlesex and Worcester Counties, Massachusetts: U.S. Geol. Survey Geophys. Inv. Map GP-741, scale 1:24,000, 1971.

00340 **U.S. Geological Survey.** Aeromagnetic map of the Westford quadrangle, Middlesex County, Massachusetts: U.S. Geol. Survey Geophys. Inv. Map GP-742, scale 1:24,000, 1971.

00341 **U.S. Geological Survey.** Aeromagnetic map of the Billerica quadrangle, Middlesex County, Massachusetts: U.S. Geol. Survey Geophys. Inv. Map GP-743, scale 1:24,000, 1971.

00342 **U.S. Geological Survey.** Aeromagnetic map of the Danville quadrangle, Pittsylvania County, Virginia, and Casewell County, North Carolina: U.S. Geol. Survey Geophys. Inv. Map GP-745, scale 1:62,500, 1971.

00343 **U.S. Geological Survey.** Aeromagnetic map of the Milton quadrangle, Halifax and Pittsylvania Counties, Virginia, and Casewell and Person Counties, North Carolina: U.S. Geol. Survey Geophys. Inv. Map GP-746, scale 1:62,500, 1971.

00344 **U.S. Geological Survey.** Aeromagnetic map of the South Boston quadrangle, Halifax County, Virginia, and Person and Granville Counties, North Carolina: U.S. Geol. Survey Geophys. Inv. Map GP-747, scale 1:62,500, 1971.

00345 **U.S. Geological Survey.** Aeromagnetic map of the Winstead quadrangle, Person and Casewell Counties, North Carolina: U.S. Geol. Survey Geophys. Inv. Map GP-748, scale 1:62,500, 1971.

00346 **U.S. Geological Survey.** Aeromagnetic map of the Roxboro quadrangle, Person and Granville Counties, North Carolina: U.S. Geol. Survey Geophys. Inv. Map GP-749, scale 1:62,500, 1971.

00347 **U.S. Geological Survey.** Aeromagnetic map of the Chepachet quadrangle, Providence County, Rhode Island: U.S. Geol. Survey Geophys. Inv. Map GP-778, scale 1:24,000, 1971.

00348 **U.S. Geological Survey.** Aeromagnetic map of the Georgiaville quadrangle, Providence County, Rhode Island: U.S. Geol. Survey Geophys. Inv. Map GP-779, scale 1:24,000, 1971.

00349 **U.S. Geological Survey.** Aeromagnetic map of the Pawtucket quadrangle, Providence County, Rhode Island: U.S. Geol. Survey Geophys. Inv. Map GP-780, scale 1:24,000, 1971.

00350 **U.S. Geological Survey.** Aeromagnetic map of the Attleboro quadrangle, Bristol and Norfolk Counties, Massachusetts, and Providence County, Rhode Island: U.S. Geol. Survey Geophys. Inv. Map GP-781, scale 1:24,000, 1971.

00351 **U.S. Geological Survey.** Aeromagnetic map of the Norton quadrangle, Bristol County, Massachusetts: U.S. Geol. Survey Geophys. Inv. Map GP-782, scale 1:24,000, 1971.

00352 **U.S. Geological Survey.** Aeromagnetic map of the Taunton quadrangle, Bristol and Plymouth Counties, Massachusetts: U.S. Geol. Survey Geophys. Inv. Map GP-783, scale 1:24,000, 1971.

00353 **U.S. Geological Survey.** Aeromagnetic map of the Bridgewater quadrangle, Plymouth and Bristol Counties, Massachusetts: U.S. Geol. Survey Geophys. Inv. Map GP-784, scale 1:24,000, 1971.

00354 **U.S. Geological Survey.** Aeromagnetic map of the Plympton quadrangle, Plymouth County, Massachussets: U.S. Geol. Survey Geophys. Inv. Map GP-785, scale 1:24,000, 1971.

00355 **U.S. Geological Survey.** Aeromagnetic map of part of the Plymouth quadrangle, Plymouth County, Massachusetts: U.S. Geol. Survey Geophys. Inv. Map GP-786, scale 1:24,000, 1971.

00356 **U.S. Geological Survey.** Aeromagnetic map of part of the Manomet quadrangle, Plymouth County, Massachusetts: U.S. Geol. Survey Geophys. Inv. Map GP-787, scale 1:24,000, 1971.

00357 **U.S. Geological Survey.** Aeromagnetic map of the Clayville quadrangle, Providence County, Rhode Island: U.S. Geol. Survey Geophys. Inv. Map GP-788, scale 1:24,000, 1971.

00358 **U.S. Geological Survey.** Aeromagnetic map of the North Scituate quadrangle, Providence County, Rhode Island: U.S. Geol. Survey Geophys. Inv. Map GP-789, scale 1:24,000, 1971.

00359 **U.S. Geological Survey.** Aeromagnetic map of the Providence quadrangle, Providence and Kent Counties, Rhode Island: U.S. Geol. Survey Geophys. Inv. Map GP-790, scale 1:24,000, 1971.

00360 **U.S. Geological Survey.** Aeromagnetic map of the East Providence quadrangle, Bristol County, Massachusetts, and Providence and Bristol Counties, Rhode Island: U.S. Geol. Survey Geophys. Inv. Map GP-791, scale 1:24,000, 1971.

00361 **U.S. Geological Survey.** Aeromagnetic map of the Somerset quadrangle, Bristol County, Massachusetts: U.S. Geol. Survey Geophys. Inv. Map GP-792, scale 1:24,000, 1971.

00362 **U.S. Geological Survey.** Aeromagnetic map of the Assonet quadrangle, Bristol and Plymouth Counties, Massachusetts: U.S. Geol. Survey Geophys. Inv. Map GP-793, scale 1:24,000, 1971.

00363 **U.S. Geological Survey.** Aeromagnetic map of the Assawompset quadrangle, Plymouth and Bristol Counties, Massachusetts: U.S. Geol. Survey Geophys. Inv. Map GP-794, scale 1:24,000, 1971.

00364 **U.S. Geological Survey.** Aeromagnetic map of the Snipatuit Pond quadrangle, Plymouth County, Massachusetts: U.S. Geol. Survey Geophys. Inv. Map GP-795, scale 1:24,000, 1971.

00365 **U.S. Geological Survey.** Aeromagnetic map of the Wareham quadrangle, Plymouth and Barnstable Counties, Massachusetts: U.S. Geol. Survey Geophys. Inv. Map GP-796, scale 1:24,000, 1971.

00366 **U.S. Geological Survey.** Aeromagnetic map of part of the Sagamore quadrangle, Plymouth and Barnstable Counties, Massachusetts: U.S. Geol. Survey Geophys. Inv. Map GP-797, scale 1:24,000, 1971.

00536 **U.S. Geological Survey.** Aeromagnetic map of parts of the Walker Lake, Reno, Chico, and Sacramento 1° by 2° quadrangles, Nevada-California: U.S. Geol. Survey Geophys. Inv. Map GP-751, scale 1:250,000, 1971.

07769 **U.S. Natl. Aeronaut. and Space Adm.** Earth Resources Aircraft Program, status review, 2d Ann., Houston, Tex., 1969 — V. 1, Geology and geography; V. 2, Agriculture, forestry, and sensor studies; V. 3, Hydrology and oceanography: Houston, Texas, U.S. Natl. Aeronautics and Space Admin., Manned Spacecraft Center, paged separately, illus., tables [1970,].

This review of the Earth Resources Program emphasizes results of analysis of data obtained with Manned Spacecraft Center and other aircraft. The conference was arranged in conjunction with the Departments of Interior, Agriculture, and Navy and was divided into the disciplinary areas of Geology, Geography, Hydrology, Agriculture and Forestry, and Oceanography; an additional session was held on instrumenta-

tion. Nine papers are separately cited from Volume 1, 11 from Volume 2, and 5 from Volume 3. — VSN

00579 **Valentine, James W.** Resource supply and species diversity patterns: Lethaia, v. 4, no. 1, p. 51-61, table, 1971.

The adaptive strategies pursued by organisms faced with different trophic resource regimes may play a major role in diversity regulation. Selection for fitness in resource-rich or resource-unstable environments favors generalized, inefficient populations and results in low diversity; selection for fitness in resource-poor or resource-stable environments favors specialized, efficient populations and results in high diversity. Therefore, insofar as trophic resource levels influence diversifications and extinctions, diversification should be associated with lower, and extinctions with higher, resource levels. This conclusion is directly opposed to that of most recent investigators. — *from* Author's abstract

vanBoeckel, J. *See* Gibb, R. A. 07675

08036 **vanEverdingen, R. O.** The Ink Pots, a group of karst springs in the Rocky Mountains near Banff, Alberta — Reply to R. F. Legget [1970 discussion of 1969 paper]: Canadian Jour. Earth Sci., v. 7, no. 2, pt. 1, p. 552, 1970.

The original paper appeared in ibid., v. 6, no. 4, pt. 1, p. 545-554, 1969; Abs. North American Geology, February 1970; discussion by Legget, ibid., v. 7, no. 2, pt. 1, p. 551, 1970.

08057 **vanEverdingen, R. O.** The Paint Pots, Kootenay National Park, British Columbia — Acid spring water with extreme heavy-metal content: Canadian Jour. Earth Sci., v. 7, no. 3, p. 831-852, illus., tables, 1970.

The Paint Pots, a group of mineral springs in Kootenay National Park, produce acid water (pH = 2.5 to 3.5) with a high content of Fe, Zn, Mn, and Pb, derived from sulfide mineralization in Cambrian rocks. Oxidation of the Fe^{++} in the water and hydrolysis of resulting Fe^{+++} produce a still lower pH in the water, a high redox potential, and a deposit of ferric (oxy) hydroxide. Less than half the available iron, approximately three-quarters of the Mn and Zn, and most of the Pb are discharged into the Vermilion River; strong dilution provided by high flow rate of the river prevents any serious pollution. A simple laboratory test shows that circulation of the acid spring water through crushed limestone will remove all iron, introduce some oxygen, and reduce both acidity and redox potential to normal surface water values; Zn, Mn, and Pb are probably removed incompletely. — *from* Author's abstract

00589 **Vanoni, Vito A.** (and others). Sediment transportation mechanics — [Pt.] H, Sediment discharge formulas: Am. Soc. Civil Engineers Proc., v. 97, paper 8076, Jour. Hydraulics Div., no. HY4, p. 523-567, illus., tables, 1971.

Thirteen well-known sediment discharge formulas are presented with a view to making them convenient to use. The basis for each formula is outlined, and results of measured bed sediment discharge on two sand bed streams are compared with values calculated with each of the 13 formulas. This is done on a graph of sediment discharge against water discharge for the two streams. In these calculations the relation between water depth, velocity and discharge was calculated by the Einstein-Barbarossa method. These comparisons of results calculated by formulas with measurements and with each other are interesting in that they bring out the great variability of the calculated sediment discharges. However, they are of only limited value in determining the general reliability of each formula. — Authors' abstract

00553 **Vaz, J. Eduardo; Senftle, Frank.** Thermoluminescence study of the natural radiation damage in zircon: Jour. Geophys. Research, v. 76, no. 8, p. 2038-2050, illus., tables, 1971.

The effects of natural radiation damage on gamma-ray induced thermoluminescence (TL) in gem-quality zircons from Ceylon has been examined before and after anneal-

ing at 950°C for 20 hours in a nitrogen atmosphere. Natural radiation damage is shown to reduce the TL output by a factor of 10^3, whereas annealing restores the TL. The restoration is α-dose dependent, and can be accounted for by the breakdown of the crystal structure by α-recoil damage and recovery of the crystallinity after annealing. The data are used to develop a qualitative model of the process of α-recoil damage based on that suggested by Pellas [1965]. — Authors' abstract

Veith, K. F. *See* Sorrells, G. G. 00466

07761 **Vest, E. L., Jr.** Oil fields of Pennsylvanian-Permian Horseshoe atoll, West Texas, *in* Geology of giant petroleum fields — Symposium, AAPG, 53d Ann. Mtg., Oklahoma City, Okla., 1968: Am. Assoc. Petroleum Geologists Mem. 14, p. 185-203, illus., table, 1970.

This arcuate chain of reef mounds, late Paleozoic bioclastic debris in the Midland basin interior, is 175 mi long and locally 3000 feet thick. Pennsylvanian limestone, 1800 feet, developed primary dips of 8° along the margins; with an early Permian 1100-ft addition of limestone on the southwest side of the reef, the atoll was then buried by prograding terrigenous clastics from the northeast. Later westward tilting elevated the eastern Pennsylvanian mounds 1400 feet higher than the southwestern Permian ones. Updip migration of hydrocarbons filled eastern mounds to spill point; along the crest, fifteen fields contain 2.54 billion bbl of recoverable oil. The Scurry field, giant 73,000 productive acres with a maximum oil column of 765 feet, ultimately will yield 1.72 billion bbl; discovered in 1948, it has produced 521 million of the total 857 million bbl from the reef crest. — GDC

Villamar V., M. *See* Sanchez Z., J. 07791

07848 **Viniegra O., Francisco; Castillo-Tejero, Carlos.** Golden Lane fields, Veracruz, Mexico, *in* Geology of giant petroleum fields — Symposium, AAPG, 53d Ann. Mtg., Oklahoma City, Okla., 1968: Am. Assoc. Petroleum Geologists Mem. 14, p. 309-325, illus., tables, 1970.

Even with continuing exploration, exploitation, and discovery of new fields along the perimeter of the Golden Lane, the origin of this Cretaceous atoll is still controversial. Most widely accepted is the hypothesis of a late Neocomian biohermal reef on a late Kimeridgian element called "Isla de Tuxpan." Locally within the atoll rim are evaporite, calcarenite, and dolomite; elsewhere sedimentary rocks are rudistid-bearing or miliolid limestone, which underlie its prominent belt of structural culminations. Only three wells have penetrated the reef core, and drilling data can be interpreted in more than one way. Notwithstanding the depositional environment in which rudistids are believed to have lived, the reef's morphology will continue to be a subject of conjecture. Cumulative production from the Golden Lane fields, through 1967, was about 1.25 billion bbl of oil. — *from* Authors' abstract

08056 **Voight, Barry; Dahl, H. D.** Numerical continuum approaches to analysis of nonlinear rock deformation: Canadian Jour. Earth Sci., v. 7, no. 3, p. 814-830, illus., 1970.

In the continuum approach to problems of geologic mechanics, the ground surrounding a deformation zone is replaced mathematically by an idealized material that deforms in accordance with principles of continuum mechanics. Studies published to date, few in number, have often followed a methodology characterized by restrictive material property and boundary condition assumptions. To avoid these difficulties, emphasis in this paper is given to modern numerical methods. Discrete-element formulations of matrix structural analysis are shown to be particularly useful, inasmuch as they are adaptable to solutions of systems characterized by nonlinear anisotropic materials, heterogeneously distributed, containing internal discontinuities, and of arbitrary topographic or internal boundary configuration. — *from* Authors' abstract

00578 **Voigt, Ehrhard.** The cheilostomate nature of the alleged cyclostomatous bryozoan genus *Dysnoetopora*: Lethaia, v. 4, no. 1, p. 79-100, illus., 1971.

Dysnoetopora celleporoides Canu and Bassler, 1926, from the Maestrichtian Ripley Formation at Coon Creek, McNairy County, Tenn., is not a cyclostomate but a cheilostomate bryozoan, as is shown by the large avicularia, subsemicircular apertures (suggesting an operculum), septulae with true rosette plates, and ascopores below the aperture. Interzoidal pores and pseudopores, characteristic of cyclostomates, are lacking. In the arborescent dichotomous zoarium, an axial bundle of long, prismatic zooecia is surrounded by a thick layer of shorter, irregular cumulating zooecia. The presence of ascospores excludes the genus from Celleporidae and related families; Dysnoetoporidae, n.fam., is erected for it. Species besides the genotype are *D. dimissa* (White), 1874, Upper Cretaceous, Colorado and Wyoming, and *D.? confusa* Voigt, 1951, Maestrichtian, Germany. – VMJ

07739 **VonOsinski, W. P. C.** Geology and production history of the Bakken Formation of the Rocanville area, southeastern Saskatchewan: [Regina] Saskatchewan Dept. Mineral Resources, 25 p., illus., 1970.

The study area is located in southeastern Saskatchewan where it abuts against the Manitoba-Saskatchewan border. [The rocks described, Upper Devonian to Lower Mississippian, dip to the southwest into the Williston Basin, in all probability without outcrop in Saskatchewan; it is believed the strata wedge out in the subsurface north of the study area.] The Bakken Formation, which is under consideration, consists of two black shales with a massive grey-green silty sandstone between. The sandstone is the producing horizon and oil occurs in stratigraphic traps. The structure is relatively uncomplicated. The Rocanville Bakken Sand Pool has been producing since 1957. — Author's abstract

00434 **Voorhies, M. R.** Paleoclimatic significance of crocodilian remains from the Ogallala Group (upper Tertiary) in northeastern Nebraska: Jour. Paleontology, v. 45, no. 1, p. 119-121, illus., 1971.

Fossil crocodilians occur at four collecting sites in the Valentine and Ash Hollow Formations in Antelope and Knox Counties, Nebraska. These, along with remains of other aquatic and semi-aquatic vertebrates, suggest the persistence (or recurrence) of the subtropical sluggish stream habitat in eastern Nebraska well into late Tertiary time. — Author's abstract

08025 **Wagner, W. R.** Invertebrate and plant fossils, [Chap.] 6 *in* Geology of the Pittsburgh area: Pennsylvania Geol. Survey, 4th ser., [Bull.] G 59 (General Geology Rept.), p. 71-80, illus., 1970.

Invertebrate and plant-fossils of the Pittsburgh area are illustrated and briefly described in this section. The most common ones are brachiopods, crinoid columns, the coelenterate *Lophodophyllidium*, and bryozoa, as well as a fossil bush 0*Sphenophyllum*, Pennsylvanian trees, ferns and fern-like plants. — EH

07843 **Wagner, Walter R.** (and others). Geology of the Pittsburgh area: Pennsylvania Geol. Survey, 4th ser., [Bull.] G 59 (General Geology Rept.), 145 p., illus., 1970.

This book is intended mainly for the interested adult and the secondary school earth science teacher as an introduction to the geology of Pittsburgh and Allegheny County. It interprets the geology in and around Pittsburgh with emphasis on specific localities that may be readily visited and which illustrate basic principles of the geology. Most of the localities discussed in the text are keyed to a county location map and detailed location maps and descriptions are given in an appendix. A series of reports by various authors, which are cited separately, cover different aspects of the geology of the area. — EH

Waite, William P. *See* MacDonald, Harold C. 00450

07699 **Walcott, R. I.** Reply [to panel discussion on isostasy], *in* Symposium on recent crustal movements, Ottawa, Canada, 1969, Papers: Canadian Jour. Earth Sci., v. 7, no. 2, pt. 2, p. 733-734, 1970.

This paper replies to discussions by Crittenden, Bloom, and Broecker, ibid., p. 727-733, of the original paper by this author, ibid., p. 716-727. — HRC

07746 **Walcott, R. I.** Isostatic response to loading of the crust in Canada, *in* Symposium on recent crustal movements, Ottawa, Canada, 1969, Papers: Canadian Jour. Earth Sci., v. 7, no. 2, pt. 2, p. 716-727, illus., 1970.

A smoothed free air anomaly map of Canada indicates that the central part of the region occupied by the Laurentide ice sheet is over-compensated. Due to the close association of the free air gravity, the apparent crustal warping, the time of deglaciation, and the congruence of the gravity anomalies and the Wisconsin glaciation, it is concluded that the over compensation is due to incomplete recovery of the lithosphere from the displacement caused by the Pleistocene ice loads. Amplitude of anomalies suggests that substantial uplift has yet to occur. Other calculations show (a) a purely elastic forebulge is not likely to reach an amplitude of more than a few tens of meters, (b) the crust will be depressed by a considerable distance beyond the edge of the ice sheet, and (c) for large ice sheets, crustal failure will probably occur in a preferential zone several hundred km inside the maximum ice limit. — *from* Author's abstract

08064 **Walcott, R. I.** An isostatic origin for basement uplifts: Canadian Jour. Earth Sci., v. 7, no. 3, p. 931-937, illus., 1970.

The tectonics involved in the structural development of uplifts in the stable platforms are suggested to be a natural consequence of loading the platform by sedimentary rocks. Any original compensated topography on the platform will cause differential loading with sediments thicker and the load greater in the valleys than over the hills. If the wavelength of topography is large, differential vertical movements can occur causing an amplification of the original topography and the growth of an arch. If the wavelength lies in a critical region defined by the flexural rigidity of the lithosphere, stress differences within the lithosphere caused by the loading may exceed the elastic limit producing faulting and the development of horsts. The Boothia Uplift, the Early and Middle Paleozoic development of the Peace River Uplift and other structures in Canada are suggested to be examples of such a process. — Author's abstract

07723 **Waldman, M.** A teiid lizard jaw from the Cretaceous of Alberta, Canada: Canadian Jour. Earth Sci., v. 7, no. 2, pt. 1, p. 542-547, illus., 1970.

The right mandibular ramus of a lizard from the Oldman Formation (Late Campanian: Upper Cretaceous) of Alberta is described. The specimen is ascribed to the suborder Scincomorpha, family Teiidae, and is placed in the genus *Chamops*, being closely allied to *Chamops segnis* from the Lance Formation (Maestrichtian). No specific identification is given, as the dentition is insufficiently well-preserved for this purpose. The specimen is believed to have formed part of the faeces of a crocodile of the genus *Leidyosuchus*. — Author's abstract

08069 **Waldman, M.** Comments on a Cretaceous coprolite from Alberta, Canada: Canadian Jour. Earth Sci., v. 7, no. 3, p. 1008-1012, illus., 1970.

A coprolite (N.M.C. 13565) containing remains of gar-pike, from the Upper Cretaceous, nonmarine, Oldman Formation of Alberta is believed to be that of a crocodile, although it may be possibly derived from a terrestrial carnivorous reptile of necrophagic or piscivorous habit. X-ray diffraction studies show the specimen to be composed of apatite. — Author's abstract

00396 **Walker, Wilfred.** Mantle cells and mineralization [abs]: Econ. Geology, v. 66, no. 1, p. 209, 1971.

08059 **Wallis, R. H.** A geological interpretation of gravity and magnetic data, northwest Saskatchewan: Canadian Jour. Earth Sci., v. 7, no. 3, p. 858-868, illus., 1970.

The striking 'fit' of aeromagnetic and gravity data from the Precambrian of northwest Saskatchewan, combined with known and nearby analogous, geological relation-

ships, suggests the presence of a northeast-trending belt, 250 × 20 miles (400 × 30 km), of early Proterozoic (,) metasedimentary rocks, probably magnetite-bearing meta-arkoses. This structural-sedimentary unit might have economic possibilities analogous to other northeast-striking, Precambrian, lower Proterozoic (,), metasedimentary belts of northern Saskatchewan, the Virgin River Belt, and the Wollaston Trend. — Author's abstract

07734 **Wampler, J. Marion; Neathery, Thornton L.; Bentley, Robert D.** Age relations in the Alabama Piedmont, *in* Geology of the Brevard fault zone and related rocks of the Inner Piedmont of Alabama — Alabama Geol. Soc. field trip, 8th Ann., 1970, guidebook: University, Ala., Alabama Geol. Soc., p. 81-90, illus., table, 1970.

Apparent K-Ar radiometric age dates from six structural blocks and three fault zones in the Alabama Piedmont range from 369 m.y. to 284 m.y. The general distribution shows the oldest date to be in the northwest and the youngest to be in the southeast. K-Ar dates from the principal fault zones indicate that the last movement was about 300 m.y. ago. These K-Ar dates do not appear to be compatible with present concepts of Appalachian orogeny in the Valley and Ridge. — Authors' abstract

00448 **Wanless, R. K.; Stevens, R. D.** Note on the age of diabase dykes, Anticosti Island, Quebec: Geol. Assoc. Canada Proc., v. 23, p. 77-78, table, 1971.

K-Ar dating of three diabase samples from the westernmost dike at De Puyjalon Cliff, Anticosti Island, gave highly discordant dates and in disagreement with the 1967 dating (138 ± m.y.) of sample GSC-65-129. The potassium content was redetermined using mass spectrometric isotope dilution procedures and results obtained were checked by X-ray fluorescence techniques, and found to be in reasonable agreement with an average value of 179 m.y. or about 40 m.y. older than the 1967 date. Redating of the original sample using the same dilution technique for potassium yielded an age of 176 ± 1 m.y. The time of dike emplacement is given by the grand average value of 178 ± 8 m.y., or mid—upper Jurassic. — VSN

07954 **Ward, William Cruse.** Diagenesis of Quaternary eolianites of NE Quintana Roo, Mexico [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 31, no. 6, p. 3489B, 1970.

Warne, A. H. *See* Dibblee, T. W., Jr. 08015

Warren, Clifton. *See* Adams, William M. 00404

07707 **Watson, Jerry A.; Johnson, G. Leonard.** Seismic studies in the region adjacent to the Grand Banks of Newfoundland: Canadian Jour. Earth Sci., v. 7, no. 2, pt. 1, p. 306-316, illus., 1970.

A detailed survey by Texas Instruments Incorporated under contract to the United States Naval Oceanographic Office in the vicinity of the southeast Newfoundland Ridge suggests that this ridge is structurally controlled and related to the northern extent of the Jurassic Atlantic basin. Possible salt diapirs were found in the Sohm Abyssal Plain and lower continental rise. Evidence of formerly greater bottom current activity in the region is suggested by the presence of buried abyssal anti-dunes. — Authors' abstract

Watson, Kenneth. *See* Rowan, L. C. 07774

Watson, R. D. *See* Rowan, L. C. 07774

Weaver, N. L. *See* Murphy, J. R. 00470

07955 **Weaver, Robert Michael.** Montmorillonite genesis in soils as influenced by the activities of monosilicic acid and various cations in the matrix solution [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 31, no. 6, p. 3110B, 1970.

07708 **Webber, P. J.; Richardson, J. W.; Andrews, J. T.** Post-glacial uplift and substrate age at Cape Henrietta Maria, southeastern Hudson Bay, Canada: Canadian Jour. Earth Sci., v. 7, no. 2, pt. 1, p. 317-325, illus., tables, 1970.

The postglacial emergence curve of Cape Henrietta Maria suggests that during the last 1000 years uplift has been about 1.2 m per century. Extrapolation to likely dates of deglaciation indicates a maximum marine inundation of > 300 m. The current rate of uplift, and the hypothetical elevation of the marine limit are the highest estimations to date for eastern and arctic Canada and support the hypothesis that a center of uplift and ice-loading is situated in southeastern Hudson Bay and northern James Bay. The derived emergence curve was used to construct an isochrone map of Polar Bear Park which will be the basis for future biological studies of community migration and succession. — *from* Authors' abstract

00457 **Weir, Gordon W.** Geologic map of the Lancaster quadrangle, Lincoln and Garrard Counties, Kentucky: U.S. Geol. Survey Geol. Quad. Map GQ-888, scale 1:24,000, sections, text, 1971.

The map includes structure contours on top of the Ashlock Formation. Ordovician to Mississippian rocks are described in detail in a columnar section. No exploratory wells have yielded oil or gas in commercial quantities. The fine-grained limestone of the Gilbert Member of the Ashlock Formation has been quarried on a small scale. None of the formations contain significant aquifers. — ESL

00459 **Weir, Gordon W.; Lee, K. Y.; Cassity, Paul E.** Geologic map of the Bighill quadrangle, east-central Kentucky: U.S. Geol. Survey Geol. Quad. Map GQ-900, scale 1:24,000, sections, text, 1971.

The geologic map includes structure contours on the base of the New Albany Shale. Underlying rocks are Ordovician-Pennsylvanian; detailed descriptions are given with a columnar section. Some stone is produced for road building and rough building stone. Lenses of coal occur sporadically but are not worked. Only small shows of oil and gas were found in exploratory wells. Ground-water sources of parts of east-central Kentucky were described in Hall and Palmquist (1960). — ESL

08049 **Wells, Philip V.** Vegetational history of the Great Plains — A post-glacial record of coniferous woodland in southeastern Wyoming, *in* Pleistocene and recent environments of the central Great Plains: Kansas Univ. Dept. Geology Spec. Pub. 3, p. 185-202, illus., tables, 1970.

A remarkable record of postglacial coniferous vegetation is reported from the floor of the Laramie Basin, which lies in the rain-shadow of high mountains and is more arid than the treeless grasslands of the High plains to the east of the Laramie Range in southeastern Wyoming. Plant macrofossils range in size from massive logs of western red cedar up to four feet in diameter, exposed or partly buried in eolian sand deposits, to leaves, cones, and seeds of red cedar and western yellow pine, preserved in ancient, rock-sheltered woodrat middens. Radiocarbon ages of the outer sapwood of 10 cedar logs range from 205 ± 95 to 1735 ± 80 yr. The scatter over the time interval of 1500 yr, suggests a secular trend to more arid climate rather than catastrophic mortality. Ages of two woodrat deposits containing remains of ponderosa pine and red cedar are 1860 ± 80 and 4060 ± 80 yr. — *from* Author's abstract

Wells, Steve G. *See* Powell, Richard L. 00539

Wendland, Wayne M. *See* Bryson, Reid A. 08045

08043 **Wendorf, Fred.** The Lubbock subpluvial, *in* Pleistocene and recent environments of the central Great Plains: Kansas Univ. Dept. Geology Spec. Pub. 3, p. 23-35, illus., 1970.

The Lubbock subpluvial was an episode of markedly cooler summers and more effective precipitation, recorded at two localities on the Llano Estacado and dated by radiocarbon between 8300 and 8600 B.C. The Folsom occupation of this area over-

laps this climatic event. Pollen spectra indicate that a boreal forest of pine and occasional spruce developed on the Llano at this time. Several invertebrate and diatom assemblages provide additional data on the changes in the environment just prior to, during, and immediately after, this event. Several hypotheses concerning the cultural responses of the Folsom hunters to these environmental changes are proposed but not tested. — Author's abstract

00397 **Wertz, Jacques B.** An apparent stratigraphic control of some copper mining districts in southeast Arizona [abs]: Econ. Geology, v. 66, no. 1, p. 209, 1971.

00405 **Westermann, D. T.; Jackson, T. L.; Moore, D. P.** Effect of potassium salts on extractable soil manganese: Soil Sci. Soc. America Proc., v. 35, no. 1, p. 43-46, illus., tables, 1971.

Incubation experiments with an acid, poorly drained soil showed that the application of KBr, KCl, KNO_3, or K_2SO_4 influenced the level of extractable Mn. The majority of the salt effects were shown to be related to salt-associated pH changes, ionic strength effects were nonsignificant, and biological activity was not a factor. KCl and KBr had an effect on the level of extractable Mn that was in addition to their general salt effect. A hypothesis is presented to explain the KCl or KBr effect in which the anion would function in an oxidation-reduction reaction. — Soil brief

Wheeler, J. O. *See* Douglas, R. J. W. 07974

Wheeler, W. H. *See* Daniels, R. B. 00413

00416 **Whisonant, Robert C.** Heavy mineral analysis of the Parkwood Formation, central Alabama: Southeastern Geology, v. 12, no. 3, p. 183-188, illus., table, 1971.

The Parkwood Formation of Carboniferous age constitutes part of the Paleozoic sequence exposed in the Valley and Ridge province of north-central Alabama. Analysis of the heavy mineral fraction of sandstones within this formation indicates a source terrane made up primarily of low-rank metamorphic rocks. Evidently, older, undeformed sediments also contributed to the Parkwood detritus. The source area was located probably within the Piedmont complex of eastern Alabama. Consideration of the angularity of the constituent quartz grains together with previous paleocurrent data further supports the idea of a Parkwood provenance situated close by to the east or southeast. — Author's abstract

00505 **Whitcomb, Harry S., Jr.** A decade of international cooperation brings a standard seismic point of view: Earthquake Inf. Bull., v. 3, no. 1, p. 16-19, illus., 1971.

The author describes the international program for earthquake observation, the worldwide network of 115 seismic stations in 61 countries and territories, and new techniques of recording earthquakes and exchanging data. In 1960 under the Coast and Geodetic Survey (now the National Ocean Survey) a plan for standardization of equipment and records was implemented. Standard systems have been installed at all stations and personnel trained to operate them. The network will be essentially complete in 1971. The National Earthquake Information Center, established in Washington, D.C., and later moved to Asheville, N.C., collects and reproduces all data and makes records available to scientists for a nominal fee. — EH

00374 **White, D. E.; Muffler, L. J. P.; Truesdell, A. H.** Vapor-dominated hydrothermal systems compared with hot-water systems: Econ. Geology, v. 66, no. 1, Bateman issue, p. 75-97, illus., tables, 1971.

Vapor-dominated geothermal systems require relatively potent heat supply and low permeability; net discharge exceeds recharge. A vapor-dominated reservoir is a two-phase heat-transfer system, above a deep water (brine,) table from which vapor boils, and below a zone in which most of the steam condenses. Vapor rises through the larger channels and the return flow of condensate is mainly through small pores and channels. The zone of condensation above and outside the vapor-dominated reservoir is a likely site for formation of deposits of mercury, which can be transferred in

the vapor phase. The zone of boiling brine below the vapor-dominated reservoir fulfills many of the conditions required for porphyry-copper formation. — WSW

00368 **White, Walter S.** A paleohydrologic model for mineralization of the White Pine copper deposit, northern Michigan: Econ. Geology, v. 66, no. 1, Bateman issue, p. 1-13, illus., tables, 1971.

As an example of quantitative evaluation of the paleohydrology of an ore deposit, calculations are presented for models that involve lateral migration of fluids through the subjacent Copper Harbor Conglomerate to the site of the deposit and stripping of copper as the solutions percolated upward through the Nonesuch Shale. Some of the limitations to theories of origin, not evident from purely qualitative considerations, could be useful to exploration. According to the percolation models, the White Pine deposit exists because the underlying conglomerate thins rapidly in the area of the deposit. Water of compaction is an adequate source only if solution paths converge appreciably. — WSW

White, Wilbert I. *See* Gillard, Douglas R. 07986

Whitmore, D. R. E. *See* Land, A. H. 07972

Wigley, Perry B. *See* Kepferle, Roy C. 00461

Williams, H. *See* Poole, W. H. 07973

Williams, Harvell P. *See* Bell, Curtis C. 07995

00599 **Williams, Philip B.; Kemp, Patrick H.** Initiation of ripples on flat sediment beds: Am. Soc. Civil Engineers Proc., v. 97, paper 8042, Jour. Hydraulics Div., no. HY4, p. 505-522, illus., 1971.

For natural sands under turbulent water flow ripples are found to form on a flat bed from small deformations caused by the random action of high turbulent velocities close to the bed. The deformations affect the grain movement pattern so as to form a bed disturbance or collection of grains that induce a separation eddy to form. The height of such a disturbance is of the order of two or three grain diameters and a height-to-length ratio of 1 to 100. Sands with median diameters of 137 and 495 micron were used in the experiments. Grass' definition of initial movement of fine sediment was extended by the experiments to define the critical conditions for initiation of ripples from a flat bed. In additional experiments the grain Reynolds Number was varied by varying the temperature and thus the viscosity of the water. The results suggest that the described mechanism of ripple formation does not operate for grains larger than 600 micron at normal temperatures. — Authors' abstract

00415 **Windom, H. L.; Beck, K. C.; Smith, R.** Transport of trace metals to the Atlantic Ocean by three southeastern rivers: Southeastern Geology, v. 12, no. 3, p. 169-181, illus., tables, 1971.

Composition of trace metals in solution in estuaries of three Southeastern [Georgia] rivers are similar. Dissolved iron and possibly manganese decrease in concentration going from fresh to saline waters owing to precipitation. The composition of trace metals in suspended sediment from the estuaries of the three rivers differs, suggesting a relationship to the composition of the respective drainage basin. The total amount of trace metals transported to the Atlantic in both solution and suspension by these rivers appears to be insufficient to supply more than about 100 Km^2 of average Atlantic deep sea sediment. River runoff appears to be inadequate to explain the trace metal accumulation of North Atlantic deep-sea sediments. — Authors abstract

00411 **Wing, Richard S.** Structural analysis from radar imagery of the eastern Panamanian Isthmus, Pt. 1: Modern Geology, v. 2, no. 1, p. 1-21, illus., tables, 1971.

Recent radar coverage of Eastern Panama has provided surface geologic data relavent to global tectonics. Distortion within a N-trending left-lateral en echelon an-

ticline belt and in the Maje Range is compatible with postulated left-lateral movement at depth. The Panamanian Isthmus, in the southwest corner of the Caribbean plate, has been subjected to compression from active translation of the South American plate. Eastern Panama has been affected by left-lateral simple shear because of oblique orientation of principal compressive stress relative to the nonhomogeneous make-up of the Isthmus. In addition, the Caribbean plate has been moving eastward, relative to South America, and drag between them may account for right-lateral transisthmus distortion. The last movements along longitudinal wrench faults of the Maje Range have been for vertical tectonic adjustments, and horizontal bending of San Blas Range has been by an intricate system of left-lateral shears and interspersed tears. — VSN

07786 **Wise, Sherwood W., Jr.** Microarchitecture and mode of formation of nacre (mother-of-pearl) in pelecypods, gastropods, and cephalopods: Eclogae Geol. Helvetiae, v. 63, no. 3, p. 775-797, illus., table, 1970.

Variations in the mode of calcification of the nacreous layer of mollusk shells impress patterns on the internal microarchitecture of the shells which have taxonomic significance. Microarchitectural patterns in the nacre can be correlated with evolutionary tendencies and ecological adaptations of the major groups of mollusks. Shell microstructures and substructures will serve as useful indexes in studies of molluskan phylogeny as more data become available from scanning electron microscope investigations. — DBV

00541 **Wittkopp, Raymond W.** Electron-beam microprobe analysis: Minerals Sci. and Eng., v. 3, no. 1, p. 17-25, illus., table, 1971.

The history and theory of the electron-beam microprobe is briefly reviewed. Current techniques and applications are discussed, and factors that might affect the quality of microprobe analysis are considered. Recent developments and trends [bulk analysis of rocks; modal analysis; luminescent mineral properties; computer control of instrument; development of ion-beam microprobe] in microprobe analysis are reviewed. — Author's abstract

07879 **Wolf, Karl H.** A collection of scientific sayings and quotations, [Pt.] 3: Earth-Sci. Rev., v. 6, no. 6, p. 467-472, 1970.

This is the final installment of the series of sayings and quotations started in Earth-Science Reviews, v. 6, no. 4 and continued in v. 6, no. 5 [Abs. North American Geology, May and July 1971]. — VSN

00531 **Wong, S. T.** Effect of stream size and average land slope on the recurrence of floods in New England: Geog. Analysis, v. 3, no. 1, p. 77-83, tables, 1971.

A principal components analysis developed previously (1963) to explain factors associated with the magnitude of floods in New England is extended to determine the effect of the stream size, as measured by length of the main stream, and average land slope on recurrence of floods in New England. With these two variables for the two basic dimensions, a multiple regression model of the form: $Q_{2.33} = aL^bS^c$ is constructed, where $Q_{2.33}$ is mean annual flood, L is length of main stream, S is average land slope, a, b, and c are numerical constants of the regression equation. Nine levels of flood recurrence intervals are considered in the study; the effect of the two variables on flood recurrence at these nine levels is considerable and fairly uniform over time. — VSN

Woodside, John. *See* Ruffman, Alan. 07709

07890 **Wray, John L.; Playford, Phillip E.** Some occurrences of Devonian reef-building algae in Alberta: Bull. Canadian Petroleum Geology, v. 18, no. 4, p. 544-555, illus., tables, 1970.

Marine calcareous algae capable of erecting self-supporting, skeletal frameworks are quantitatively important constituents in some Upper Devonian (Frasnian) carbonate

complexes in Alberta. The blue-green algae, *Renalcis* and *Sphaerocodium*, and the provisionally classified red alga, *Keega*, are recorded and illustrated from facies in the Redwater and Virginia Hills fields. These same algae occur in reef facies in the Devonian Canning Basin reef complexes in Western Australia where *Renalcis* and *Sphaerocodium* are major framebuilding constituents. — Authors' abstract

07732 **Wright, H. E., Jr.; Mattson, L. A.; Thomas, J. A.** Geology of the Cloquet quadrangle, Carlton County, Minnesota: Minnesota Geol. Survey Geol. Map Ser. GM-3, 30 p., illus., tables, geol. map, 1970.

Precambrian rocks, exposed in St. Louis River valley near west end of Lake Superior, are dominated by the Thompson Formation of interbedded slates and graywackes, correlated with the Animikie Group. Various sedimentary structures, clastic dikes, and calcareous and siliceous concretions are common. The stratigraphic thickness across intricate folds is probably 20,000 feet. Normal and reverse faults, and steeply dipping joints are common; cleavage is well developed in slaty units. Many microgabbro dikes were intruded during subsidence of Lake Superior syncline. Pleistocene glacial deposits mark one Rainy Lobe and three Superior Lobe phases. During final withdrawal of the ice, St. Louis River was diverted to form progressively lower erosional channels to the St. Croix River, then flowed into proglacial Lake Nemadjii, whose outlet formed the last channel in the sequence. — GDC

08047 **Wright, H. E., Jr.** Vegetational history of the Central Plains, *in* Pleistocene and recent environments of the central Great Plains: Kansas Univ. Dept. Geology Spec. Pub. 3, p. 157-172, illus., 1970.

Pollen diagrams indicate that during maximum Wisconsin glaciation, 20,000 to 14,000 yr ago, spruce forest covered most of eastern and central United States to northeastern Kansas. West of here, it may have been interrupted by a vast area of sand dunes, produced by intensive wind action from the ice sheet to the northeast. When the ice retreated, spruce forest spread as far west as the Black Hills. The climatic change that accelerated ice retreat caused the spruce forest to fail; in the western parts it was replaced directly by prairie, farther east it gave way to birch and alder in the south and to pine in the north, and these were succeeded by temperate trees; by 8000 yr ago a fully developed prairie covered the region and extended into central Minnesota. With climatic trend reversal 6000-7000 yr ago the prairie withdrew o the west, and deciduous trees now occupy slopes of depressions far out into the modern prairie. — *from* Author's abstract

07719 **Wright, J. A.** Anisotropic apparent resistivities arising from non-homogeneous, two-dimensional structures: Canadian Jour. Earth Sci., v. 7, no. 2, pt. 1, p. 527-531, illus., 1970.

Variations in electric and magnetic fields are calculated for a nonhomogeneous, two dimensional structure representing a sediment-filled graben surrounded by crystalline rocks. Apparent resistivities calculated along the cross-section profile for the electric field parallel (ρe) and perpendicular (ρh) to the strike are anisotropic. The two apparent resistivities, ρe and ρh, at a given point outside the graben, parallel each other over a broad range of periods but do not show convergence at long periods; thus, it is not necessarily an indication of nonhomogeneity at depth when ρe and ρh are different at long periods. In this case, apparent resistivity anisotropy is caused by a near-surface distortion of telluric currents. Although the ρe data are less disturbed by the nonhomogeneity, it does not seem justified to interpret ρe data in terms of Cagniard models. — *from* Author's abstract

Wright, Ramil C. *See* Bandy, Orville L. 00496

Wu, Changsheng. *See* Mateker, Emil J., Jr. 00510

Wyder, J. E. *See* Klassen, R. W. 07862

07956 **Wyss, Max.** Observation and interpretation of tectonic strain release mechanisms [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 31, no. 6, p. 3498B-3490B, 1970.

08039 **Yeh, H. C.** Interpretation of phase diagrams, *in* Phase diagrams, materials science and technology — V. 1, Theory, principles, and techniques of phase diagrams: New York and London, Academic Press, p. 167-197, illus., table, 1970.

This chapter provides a starting point for readers who have not had formal training in phase diagrams and gives a brief review of essential principles of phase diagrams for those with formal training. Basic rules and procedures of obtaining information from one-, two-, and three-component systems are illustrated, important terminology is defined, and a comprehensive bibliography is given as a guide to more detailed studies of phase diagrams. — VSN

00593 **Yeh, William W-G.; Tauxe, George W.** A proposed technique for identification of unconfined aquifer parameters: Jour. Hydrology, v. 12, no. 2, p. 117-129, illus., tables, 1971.

The technique of quasilinearization is applied to the problem of identifying the parameters in an unconfined aquifer system. This new technique is shown to be a very effective way of converting field observations based on pumping tests into the desired aquifer parameters. The procedure is straightforward as it requires neither curve plotting nor graphical matching. The parameters to be identified are the hydraulic conductivity and specific storage in an extensive unconfined aquifer system. Results and numerical experiments are presented. — Authors' abstract

07967 **York, Derek.** Recent developments in potassium-argon dating: Comments Earth Sci. — Geophysics, v. 1, no. 2, p. 47-54, 1970.

Recent trends in K-Ar dating indicate there may be some significant improvements in precision of K-Ar dating with consequent improvement and extension of the magnetic field reversal time scale, particularly by analytical refinements (isochron plots) and by Ar-40/Ar-39 dating. Attempts are also being made to further investigate the usefulness of the method in dating of shield areas by use of the Ar-40/Ar-39 technique. — VSN

08084 **Yost, Edward.** Multispectral viewers, *in* Earth Resources Aircraft Program, status review, 2d Ann., Houston, Tex., 1969 — V. 2, Agriculture, Forestry, and sensor studies: Houston, Tex., U.S. Natl. Aeronautics and Space Admin., Manned Spacecraft Center, p. 29-1—2918, illus., [1970,].

A multispectral viewer is an instrument for use in interpretation of multiband 'black and white' photography. Using two or more spatially identical photos, the device produces a single color presentation by projecting the image of one photo on top of the other, using different color light sources. The technique makes it possible to select a particular set of bands within the near ultraviolet-visible-near-infrared spectrum and to interpret results from a single color presentation. It also permits altering the color of the presentation to enhance any desired relationship. — VSN

Young, G. M. *See* Church, W. R. 08062

07998 **Young, Keith.** Geology and man — The geological basis of man's environment, *in* Environmental geology — AGI short course lecture notes, Milwaukee, Wis., 1970: Washington, D. C., Am. Geol. Inst., 120 p., paged separately, 1970.

This guide for an introductory environmental geology course consists of an outline and list of references for each of 23 lectures covering aspects of geology and related fields as they affect man and are affected by him, his attitudes toward his environment, and his behavior in relation to it and to other men. — EH

08001 **Young, Keith.** Man in the geobiocoenose, *in* Environmental geology — AGI short course lecture notes, Milwaukee, Wis., 1970: Washington, D. C., Am. Geol. Inst., 23 p., paged separately, illus., tables, 1970.

The author discusses the geobiocoenose, or ecosystem, and the phosphate, nitrogen and carbon cycles within it. He cites the need of a geochemically-oriented soil classification which will show trace mineral content of soils. As man depletes natural

soils to produce agrisols, he must replace not only soluble nitrates, phosphates and potash but also trace minerals. He destroys the geogiocoenose by applying quantities of fertilizers and pesticides to the soil which deplete humus and trace elements and produce lethal accumulations and by-products which drain into surface-water and overload the ecosystem. Pollution of the atmosphere is another example of overloading. The author questions whether man, by destroying part of the geobiocoenose, will disappear from the ecosphere. — EH

08004 **Young, Keith.** Map exercises for *The paradox of man and earth*, App. B *in* Environmental geology — AGI short course lecture notes, Milwaukee, Wis., 1970: Washington, D. C., Am. Geol. Inst., [15] p., paged separately, 1970.

Map exercises are given for 15 quadrangles in the United States. Questions pointed toward an environmental geologic approach to problems in each area, and a list of references are included. — EH

08005 **Young, Keith.** Sample field trips (Austin, Texas area), App. C *in* Environmental geology — AGI short course lecture notes, Milwaukee, Wis., 1970: Washington, D. C., Am. Geol. Inst., [4] p., paged separately, 1970.

Soils at five stops on a field trip in the Austin, Texas, area are described in relation to the environmental geology of the area. Stops on a pollution field trip and a slope stability field trip are also outlined. — EH

08029 **Young, Keith.** Erosion is here to stay, *in* Environmental geology — AGI short course lecture notes, Milwaukee, Wis., 1970: Washington, D. C., Am. Geol. Inst., 24 p., paged separately, illus., table, 1970.

Erosion due to dust storms, stream, and marine action is reviewed. Factors affecting the rate of stream erosion include the amount and distribution of precipitation, resistance of rock and soil to erosion, number, amount and abruptness of elevation changes, and the predominance of either an oceanic or a continental climate. The erosion rate can be lessened by preserving vegetation, not overgrazing the land, proper tilling methods, and by not allowing cleared land to remain bare for long, as well as by building dams and reservoirs. Long-term effects of stream deposition and sedimentation, and the building of deltas and alteration of land-sea boundaries are discussed. Engineering techniques can lessen harmful erosion and thereby decrease downstream sedimentation; however such actions can affect fertility of the soil and the flood cycle of streams. — EH

08030 **Young, Keith.** Comments on environmental geology curricula, App. A *in* Environmental geology — AGI short course lecture notes, Milwaukee, Wis., 1970: Washington, D. C., Am. Geol. Inst., 2 p., paged separately, 1970.

Courses which should be included in an undergraduate curriculum in environmental geology are listed. Supporting work for the environmental geology major and approaches to be used in graduate study are described. — EH

07913 **Yudin, I. A.** O muassanite v zheleznom meteorite Canyon Diablo [On moissanite in the Canyon Diablo meteorite]: Meteoritika, no. 30, p. 93-94, illus., 1970.

Mineragraphic investigation confirms Merrill's (1930) suggestion that there is no moissanite in the Canyon Diablo meteorite; the mineral previously identified as such probably was carborundum which fell into the meteoritic iron during cutting or polishing with powdered carborundum. — DBV

Zaitzeff, J. B. *See* Ott, W. N. 00498

07823 **Zdorovenin, V. V.** Novyye dannye o stroyenii dna Labradorskogo okeanicheskogo basseyna [New data on the structure of the bottom of the Labrador ocean basin] *in* Seysmicheskiye issledovaniya stroyeniya dna morey i okeanov: Akad. Nauk SSSR Inst. Okeanologii Trudy, v. 87, p. 114-125, illus., table, 1970.

Results are presented of regional reflection soundings made in the Labrador Sea by the R/V "Polyus," in November 1964 to February 1965. The investigations were made along two profiles crossing the southeastern part of the trough. The results of the reflection survey and of echo sounding show that in the central part of the Labrador Sea, bedrock in a structure analogous to a mid-ocean ridge, buried under sediments, rises toward the sea-floor surface. — DBV

00485 **Zimmerman, Roger P.; Taylor, Thomas N.** The ultrastructure of Paleozoic megaspore membranes [with French abs.]: Pollen et Spores, v. 12, no. 3, p. 450-468, illus., tables, 1970 [1971].

The ultrastructure and ultraarchitecture of megaspore membranes of seven species of Pennsylvanian seeds and one lycopod megaspore were investigated by transmission and scanning electron microscopy. The specimens are from coal balls, most of them from Middle or Upper Pennsylvanian of southern Illinois, and represent five pteridosperm species, *Pachytesta*, *Hexapterospermum*, *Conostoma*, two cordaitalean (*Mitrospermum*, *Taxospermum*) and the heteorsporous lycopod *Mazocarpon*. This study indicates that sufficient detail is preserved in Paleozoic megaspores to distinguish taxa at least at the generic level and to provide a basis of comparison with closely related extant forms. Exine organization in *Mazocarpon* is very different from that of the seeds, but is very similar to that of an extant *Selaginella*. — VMJ

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